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Contents.

	PAGE
Forthcoming Events	169
Cast Iron and the British Industries Fair	169
Weldings and their Reaction	169
Notes from I.B.F. Branches	170
Non-Ferrous Metals and Tariffs	170
Random Shots	170
Foundry Selling Practice	171
The Casting of Threads	172
Sand-Cast Aluminium Alloys	172
Modern Practice in Cast-Iron Testing	173
Catalogue Received	175
American Foundrymen's Association Convention	175
Iron and Steel Production	175
The Production of Ferrous and Non-Ferrous Castings for High-Class Internal Combustion Engines	176
The Modern Blast Furnace	177
Heat-Resisting Alloys	180
This Week's News in Brief	182
Trade Talk	182
Personal	182
Obituary	182
Raw Material Markets	184
Australian Tariff Amendments	184

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Forthcoming Events.

MARCH 18.

Society of Chemical Industry (Chemical Engineering Group):—Meeting at Birmingham. "Some Characteristics of Nickel and its Alloys." Paper by W. R. Barclay, O.B.E.

MARCH 22.

Sheffield Metallurgical Association:—Ordinary meeting. "Structures of Zirconium Steel." Paper by C. Sykes, D.Sc.

Institute of British Foundrymen.

MARCH 19.

Wales and Monmouth Branch:—Annual general meeting at Cardiff.

Lancashire Branch (Junior Section):—Ordinary meeting. "Observations on the Production of Light Iron Castings." Paper by F. Griffiths.

Scottish Branch:—Annual general meeting at Glasgow.

Lancashire Branch:—Special meeting. "Some Notes on Italian Steel-Foundry Practice." Paper by Dr. Guido Vanzetti.

MARCH 26.

Newcastle-upon-Tyne and District Branch:—Ordinary meeting. "A Few Hours on the Floor of a Jobbing Foundry." Paper by A. Sutcliffe.

JUNE 7-10.

Institute of British Foundrymen:—Annual Conference at Newcastle-upon-Tyne.

Cast Iron and the British Industries Fair.

After visiting the display at Castle Bromwich we were quite definitely left with the impression that this year's show was the best, from the point of view of the founding industry, that has yet been provided. Many important sections were covered. The stands showing cast-iron pipe were well done and attractive, and aroused much interest. An impressive display was afforded by the light-castings manufacturers, and each year witnesses a steady advance in the variety and excellence of the finishes available in this section; a very high standard of workmanship and appearance was realised. The stands devoted to the use of nickel, of molybdenum, soda-ash, demonstrated the keenness of the interests concerned. There was less heavy machinery than usual, and it is easy to understand the temptation which the large engineering firms must be under to reserve their exhibits for exhibitions exclusively devoted to machinery, which experience has shown to be preferable. The number and variety of the engineering exhibits, however, were very remarkable, as also were the non-ferrous and stainless-steel exhibits. The amount of foundry equipment and supply material shown was also less than in previous years, but a good deal of interest was displayed in the new electro-magnetic moulding machinery. Altogether, in spite of the natural tendency for manufacturers not selling direct to the public to confine their efforts to their own trade exhibitions, the British Industries Fair seems to be making a place for itself as a general Fair, and one which would be used by the more enterprising suppliers if the location was better.

There seems to be little doubt that, as a whole, the Fair created a much more favourable impression on this than on any previous occasion. The number of foreign buyers was greater, and a spirit of optimism was abroad among the exhibitors. We are less certain about the volume of business actually transacted, but not even the British Industries Fair can, by itself, overcome a general paralysis of world trade; this can only be cured by international action in the political, rather than the economic, sphere.

Weldings and their Reaction.

We have recently had several demands for a statement as to the trend of the competition which weldings are making against grey-iron castings. Competition has been felt in the following directions:—Electric motor casings, junction and fuse-box covers, bed plates and casings for machinery. These jobs received consideration and achieved success because of the astuteness of the designers of weldings in winning the confidence and co-operation of the engineer-buyer to an almost unprecedented extent. We feel that the competition is not increasing, but, if anything, it is diminishing in intensity. The factors now being felt are (1) that when the founder is allowed the same amount of latitude in design as the welder, a serviceable article of equal cheapness can be produced; (2) there has been a realisation that in many structures a bend is as bad as a break and in some, such as a lathe bed, infinitely worse; (3) rigidity is often a function of mass, a factor difficult to overcome even by clever design; (4) whilst lightness may be desirable, a welded structure when subjected to corrosive conditions has not the life to be expected from cast iron on the dual grounds of the relatively larger area exposed per unit mass and the inherently poor rust-resisting properties of steel weldings; (5) a doubt still remains as to the potential weakness of welds as starting points for rapid corrosion. Electric welding is, however, making great progress in the field of structural engineering, and only last week we inspected a new shop being built with a 160-ft. span. This new industry will continue to progress rapidly as soon as the mills habitually roll the sections they require. It is also making strides in the direction of repairing surface defects in castings, and buyers, now having learnt that in so much as buildings and seagoing vessels rely on welded structures, they are now appreciating that a properly filled-in blow hole is not detrimental to the serviceability of a casting. This statement, we believe, summarises the existing state of affairs.

XUM

Notes from I.B.F. Branches.

A meeting of the *Birmingham, Coventry and West Midlands Branch* was held on March 3, and took the form of a Junior Paper night. Four Papers were presented by younger members of the Branch, as follow:—"Modern Converter Practice," by W. R. Cooper; "Working a Siemens Open-Hearth Furnace for the Production of Malleable Cast Iron," by G. R. Shotton; "The Wear of Cast Iron," by A. A. Timmins; and "Moulding Two Pump Brackets," by T. W. Trayherne.

The Branch-President, Mr. F. J. Hemming was in the chair, and the Papers proved to be of a high order and provoked a good discussion. A number of lantern slides were shown illustrating the various Papers, the last-mentioned of which was illustrated by 30 excellent slides taken during various stages of the moulding and core assembly.

A vote of thanks was proposed by Mr. W. J. Molineux and seconded by Mr. G. M. Callaghan, and carried unanimously.

Several speakers paid tribute to the amount of work the lecturers must have taken in preparing their Papers, and to the high quality of the subject matter. Several of the Papers will be printed in future issues of The Foundry Trade Journal.

Scottish Branch.—At the meeting to be held in Glasgow on March 19, the John Surtees Memorial medals and prizes will be presented by Colonel A. D. McInnes Shaw, of Messrs. Shaw & McInnes, Glasgow. The annual business meeting will be held on the same day, when the annual report of the work of the Branch will be presented and election of office-bearers for next session take place. Mr. Frank Hudson will detail some experiments in the casting of iron and initiate a discussion on green-sand *versus* dry-sand moulds.

Edinburgh Section.—At a meeting held in Edinburgh on March 8, it was agreed to hold another meeting on April 2 in Heriot Watt College, when Mr. H. Gardner will read a Paper on "The Engineer in the Foundry." The following committee was elected for next session:—Chairman, Mr. W. Wallace (Brown Bros., Limited); vice-chairman, Mr. A. D. Mackenzie (Mackenzie & Moncur, Limited); and Messrs. J. Wilson, A. Bruce, R. McNaughton and J. Simpson.

Burnley Section.—At the annual general meeting, held on March 10, Mr. James Taylor was elected President, Mr. Fred Harris and Mr. Lawson Wharton Vice-Presidents, and Mr. John Pell re-elected honorary secretary and treasurer. Mr. C. Tate, Mr. Robinson and Mr. H. Meadowcroft were elected to the Council. After votes of thanks to the various retiring officers, Mr. John Jackson opened a discussion on the degasification of cast iron by means of soda ash. Mr. Jackson said the addition of soda ash to molten cast iron degasified and cleansed the metal. A bucketful of soda ash on the bed charge of coke improved the first metal tapped out of the cupola. If soda ash in the proportion of 1 per cent. was added to the metal, the sulphur content would be materially reduced. The soda ash in the form of a ball should be placed in the bottom of the ladle or shank and the molten metal poured on to it. When the shank or ladle was filled with molten metal, the surface of the metal was covered with mineral blacking or powdered limestone to collect the slag formed. The slag was of thin, frothy nature and light coloured. The metal had a higher specific gravity than metal not treated with soda ash.

After an interesting discussion Mr. J. Hogg proposed and Mr. J. Pell seconded a vote of thanks to Mr. Jackson, who suitably replied.

A mixture of crushed firebrick and fireclay is suitable for repairing furnace linings.

Non-Ferrous Metals and Tariffs.

By "Onlooker."

When the free list in connection with the Government's tariff proposals was first published, it is not too much to say that the non-ferrous metal trade was both surprised and disappointed to find that copper, lead and zinc were not included among the commodities permitted to enter the country free of duty. As essential raw materials, not produced to any large extent in this country, it was expected that no tax would be levied, and much concern was felt that steps had not been taken to safeguard the interests of consumers.

Representations were immediately made by the Metal Exchange, certain merchant interests and the consuming trades to get the non-ferrous metals listed as free imports, and, in the case of copper, scrap material and residues, these efforts were successful, but all that could be obtained for spelter and lead was a promise that careful investigation should be made into the merits of the case. With tin ore already exempted from tax, the provision to allow residues to enter free safeguarded the tin smelters, so that lead and spelter are the two metals left out in the cold.

In the non-ferrous metal group copper is the only metal which cannot at present be produced within the Empire in sufficient quantities to meet the needs of consumers in this country, and the fact that certain copper-producing companies in Canada and Africa have fallen into line on the restriction programme agreed by the cartel, makes it doubly difficult to increase output at short notice. It is also true that the present low price of the red metal affords very little encouragement to speed up production, although in the above-mentioned districts costs are among the lowest in the world. Another difficulty arises in connection with supplies of fire-refined copper, which is now used so extensively in this country, and, in fact, in the whole of Europe. This grade has been supplied from the Transvaal, Chile, Germany and Scandinavia, and our imports have been very considerable during the past few years, but while eventually there is no doubt that the Empire will be able to look after this need, that time has not come yet.

With lead and spelter, which are both subject to duty, the Empire can comfortably keep us going, and, of course, this country itself produces some 50,000 tons of spelter per annum from imported zinc concentrates. In spite of this, strong representations have been made to the Government that these two metals should be added to the free list, and it must be confessed that there appears to be very little object or justification for making them subject to an import duty. As already mentioned, Empire brands are available in sufficient quantities to look after our needs, and therefore it is inconceivable that at the present low level of values foreign metal will be able to face the handicap of a taxed entry into this market. On this showing there does not appear to be much chance of revenue from imported lead and spelter, but what is already evident is the fact that Empire brands are appreciating in value to the extent of, at any rate, part of the duty, as a result of which the manufacturer here will be handicapped in quoting against his foreign rivals who are buying at the world price.

For a long time past the galvanising industry in this country has been in a parlous state and its exports have fallen in an alarming fashion. An increase in the cost of spelter is an additional handicap which the trade is in no position to bear, and the results of the duty will be seen in further loss of orders for overseas markets. A higher price for lead adversely affects all those trades using that metal, and among them may be mentioned cable making, batteries and building. A revenue tariff should surely not be extended to essential raw materials.

Random Shots.

The topic of the week, the newspapers tell us, is the Irish Sweepstake. "The exhilarating uncertainty grips everybody." Allow "Marksman" at this point to insert a sceptic question mark, thus: ? It is his personal knowledge that a youth, resident in the purlieus of Much Hadham, is blissfully unaware of this alleged exhilarating uncertainty. And "Marksman" himself is not gripped. Experience has suggested to him that participation in these mammoth sweepstakes is, to resort to a colloquialism, a "mug's game." This year he has spent his ten shillings on a gruesome detective story and a visit to the cinema when "Frankenstein" was being shown. The total amount of exhilarating uncertainty he secured in this way reduces the Irish Sweepstake to the level of a game of snakes-and-ladders in a boarding house on a wet August day. Of course, there may be more than one point of view on this matter—"Marksman" is prepared to admit as much. Albert, it is believed, would not agree with the Bishop of Hayti. Panama Pete quite definitely does not.

* * *

Out of the wrong, however, cometh forth neatness. It is not generally known that Miss Nellie Snookers was present in Dublin when the counterfoils were delivered into the mixing machine. She was an actual witness of that solemn ceremony, and, with her characteristic inventiveness, conceived the possibility of adapting such a machine for mixing and aerating foundry sands. She is now actively engaged on the improvisation of the apparatus. Details of her experiments are not yet to hand, but "Marksman" understands that two dustbins (kindly loaned by the Eastbourne Corporation, which enthusiastically supports all scientific invention) and a spare Roots' blower are being pressed into service—especially the dustbins. Miss Snookers' efforts to introduce into the range of foundry equipment just one more British machine (to keep the other three company) has, I am sure, the best wishes of the entire industry.

* * *

A critic of *habit*, Sir Walter, whose opinions were too strong to falter, said "The dress in the Row is disgraceful, you know." Said the youngsters, "Well, don't habits alter?" Prizes will be awarded for the best alternative "last lines" for the above limerick. All entries must be submitted before February 29 next and a competition coupon (see foot of column) must accompany each.

* * *

"Marksman" was bold enough last summer to prophesy that bowler hats would one day be made of aluminium. His prediction, considerably to his own surprise, has proved a winner. A correspondent has kindly sent along the following note:—"Earnest seekers after pure harmony in modern jazz music have for some time been in the habit of concealing a 'mute' for the cornet in a coloured bowler hat. Many such hats covered with aluminium paint have been seen, and now a West-End firm of music specialists are selling a shapely bowler in aluminium. It is not clear whether lightness or enhanced appearance is the appeal of aluminium in this instance, or whether the light metal possesses unguessed-of harmonic properties."

* * *

Note.—As there is no room for a competition coupon, all entries will automatically be disqualified.

Marksman.

Foundry Selling Practice.

By Eric N. Simons.

(*Continued from page* 152.)

No. 14. CAN FOUNDRIES CO-OPERATE?

In this article it seems desirable to depart a little from the practical and deal rather with a possibility, of some importance, that has never been considered as often as it should. This is the possibility of co-operation in selling among various sections of the foundry industry. It is hoped that the author will not be regarded as having an axe to grind if he refers, in illustration of his remarks, to the steel-foundry business, which he knows better than other types of founding.

Taking the task of a steel founder as distinct from an ironfounder or a brassfounder or any other sort of founder, his business is to persuade the customer that steel castings are better than, say, malleable castings, for certain parts or purposes for which malleable castings have hitherto been used, or than wrought iron, or than "X" metal, or whatever rival in the foundry trade or other trades he may have. He sets about this task by equipping his salesmen with the necessary samples and information. His sales manager and publicity manager get to work and produce circular letters, leaflets, pamphlets, advertisements, all sorts of arresting matter, again to prove that steel is better than its rivals. They may or may not succeed, and at a glance it would be difficult to say that their efforts were other than admirable and advantageous.

How Waste Could be Eliminated.

But just across the road, or in another town, or up in Scotland, rival steel founders A and B and C and D are all doing identical things. They are all eagerly demonstrating that steel is better than some other metal or metals for specific purposes. Now, when half-a-dozen men are each doing a job that could be done just as well by, say, a couple or one of them, an economic waste exists, and one is compelled, if one has intelligence, to look into the matter and inquire whether this economic waste is justified. Candidly, the writer does not think it is. He believes that here is a definite, tangible instance in which co-operation would do all that is necessary, more economically, more efficiently and with probably even greater result.

There is no thought of preaching rationalisation or anything other than plain, straightforward, voluntary industrial co-operation. And the message is plain because here there are a dozen or more foundries doing a job which is, logically, economically and practically, a job for the group and not for the individual. Consider that in urging the use of steel as distinct from other castings, these foundries *are not competing with one another*, in the sense in which competition is to be understood. They, one and all, are in agreement, presumably, that steel is the material to use for the work. A is not swearing by steel and B contradicting him and C declaring he is open-minded. They are all swearing by steel, and wasting a lot of money about it. It produces the effect of twelve men shouting a similar but not identical message at overlapping moments through megaphones of varying sizes. The result is less efficient than would be the power of twelve men's voices bawling through one megaphone a clear and connected message.

Briefly, the work they are doing is educational work, not competitive work; and the fact that they are competing with one another in other directions only hampers and nullifies this educational work. A cannot let his educational talk about the value of steel castings for, say, switchgear work stand alone. He has, because he is tackling the job as an individual, to work in some reference to the utter superiority of his steel castings over everyone else's, which tends to make the customer sceptical as to the integrity of his educational remarks. He hears the grinding of the axe . . .

But the steel-casting industry as a whole could devote itself, if it willed, solely to these educational tasks, rub in all the facts without disconcerting side references to A or B or C, and plant them so firmly in the public mind that they would take root and sprout into inquiries and orders. And what is true of steel castings is true of aluminium castings and iron castings and every other sort of castings which are ideal for particular purposes.

A Specific Instance.

As a specific instance, manganese steel took probably twice as long to become adopted for railway and tramway trackwork as it need have done, because the various makers of manganese steel were all too busy pushing their own manganese steels to be bothered to spend the time necessary to educate users into adopting the new material. It is just as difficult to-day to persuade people who use manganese-steel liners for tube mills that chrome-alloy steel liners are better and cheaper. As long as A was advertising apples, and B advertising apples and C advertising apples, people just bought apples when they felt like it. But when the fruit growers as a body began to shout all together "Eat more fruit," everyone ate more fruit, and the sale of apples went up.

What is advocated is, in short, collective action by founders in pushing the use of their castings. If a manufacturer has always been using wrought iron for switchgear work, and A's representative calls upon him, recommending steel castings, he thinks to himself: "Oh, yes, he's laid himself out for steel castings, or he wants to get my orders away from B. And B, whom I consult on the matter, doesn't want to lose my orders for wrought iron, so he tells me A is talking nonsense. In the end, I probably stick to wrought iron, because I cannot be sure that A's recommendation is sound and disinterested. But if the collective steel foundries told me that steel was the stuff, and explained why, I should believe them without question."

A Central Association Suggested.

Now the question of ways and means at once arises. Are foundries of a particular grouping to sell collectively, and sink their individual identities into a sort of Castings Marketing Association? The answer is no, for the reason that it would not work. The foundry industries are not ready for it. But what I would suggest is the delegation by founders to a United Founders' Research Association, or something of the sort, of all that part of their selling and publicity work which is definitely educational and non-competitive. Individually they would then be free to concentrate their sales activities on direct competition with one another.

To show how this would work, one can instance certain electrical components, which are often made of wrought iron, but for which steel castings can be produced to meet all requirements, with many advantages over wrought iron. Steel founders, we will assume, are agreed that steel castings are the best type for this work. The co-operative body would first of all carry out the necessary experiments to demonstrate the superiority of steel over wrought iron. The results would then be published under the auspices of the group, circulated among engineering associations, advertised in the technical Press, and postally transmitted to electrical people generally. Technicians employed by the group would lecture to organised technical bodies. Possibly stands would be taken at exhibitions at which samples and specimens would be demonstrated. Similarly, this procedure would be adopted for pushing other types of castings where education of the consumer is needed. All the advertisements, letters, lectures, and so forth, of this collective foundry organisation would be published and given in the name of the organisation. It should stand as a whole group, and not as a bunch of individuals.

In their individual advertisements, sales work, circularising, and so forth, it would then be needless for founders to advocate the use of a particular metal. That work would already have been done. They would be free to push their own particular products. Instead of proclaiming "Use steel castings for electrical work" they could say "A's steel castings for electrical work are such-and-such-and-such . . . " (as distinct from B's).

In this brief article one can but throw out a rough sketch of the organisation envisaged. Presumably, a fund would have to be created by the various foundry groups, each contributing a sum proportionate, perhaps, to his capital or his output, or whatever other basis might be decided upon. And the organisation, once in action, would have for its primary purpose the teaching of the public to use steel castings or aluminium castings or gunmetal castings according to the type of industry represented, wherever such tuition was essential. There would, of course, be competition among the various groups. The malleable-casting association would make war on the steel-casting association, no doubt; but that is no argument against the scheme.

(*To be continued.*)

American Exports of Safety-Razor Blades.—The United States exported in 1931 some 4,448,951 doz. safety-razor blades compared with 7,921,736 doz. in 1930, a reduction of 3,472,785 doz., i.e., about 44 per cent. Exports to Germany fell from 870,789 doz. blades in 1930 to only 29,500 doz. in 1931, or by about 97 per cent. To Austria exports fell from 416,666 doz. in 1930 to 16,874 doz. in 1931, a reduction of 96 per cent. To Great Britain exports amounted to no less than 1,921,017 doz. blades in 1930 and to 1,619,012 doz. in 1931. To all the rest of Europe the fall in exports from 1,617,132 doz. blades in 1930 to 225,085 doz. in 1931 represented a reduction of about 86 per cent. Thus it will be seen that whilst exports to European tariff countries in 1931 fell by an average of about 93 per cent., exports to Great Britain were maintained within about 16 per cent. of the 1930 figure.

The following official statement has been issued by the Import Duties Advisory Committee:—The Advisory Committee are receiving a considerable number of inquiries as to their course of procedure and as to the form in which representations, either in regard to the addition of articles to the free list under the Import Duties Act, or in regard to the imposition of additional duties, should be submitted to them. They desire to point out that the power to add articles to the free list is limited during the first six months of operation of the Act to cases of special urgency, while additonal duties can only be imposed "in respect of goods of any class or description which are chargeable with the general *ad valorem* duty, and which, in their opinion, are either articles of luxury or articles of a kind which are being produced, or are likely within a reasonable time to be produced, in the United Kingdom in quantities which are substantial in relation to United Kingdom consumption." It will be of great assistance to the Committee if applicants will pay special attention to these limiting conditions in any representations they may desire to submit. In view of the short period remaining before the expiration of the Abnormal Importations (Customs Duties) Act, 1931, the Committee will obviously have to be guided at the outset mainly by considerations of a general character, leaving for later review the detailed circumstances affecting particular industries and trades and individual classes of articles.

XUM

The Casting of Threads.

By W. Schäfer.

(*Translated from "Die Giesserei."*)

In producing castings care has to be taken to produce, as far as it is practically possible, finished castings and so prevent machining later. In the following article the casting of threads in grey cast irons is described.

Naturally cast threads are only to be em-

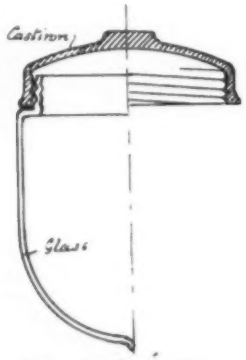

Fig. 1.—Lamp Socket with Cast-in Thread.

ployed in certain special cases. Fine and pointed threads are not suitable for casting, but rough and rounded threads can be cast economically. Cast thread can be especially employed where the casting is connected to a sheet body, as to the funnel of gramophones or loud speakers, as the sheet clings closely to the irregularities of the casting. These funnels are double

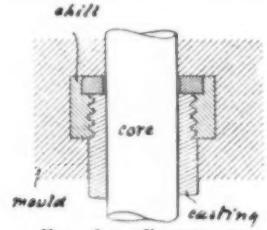

Fig. 2. — Casting the Thread with a Chill.

threaded, the starts and the ends of the threads being situated on the core seam. As in drying the core in an iron core box, the threads dry very quick and remain in the box in removing the core, the cores have to be replaced from the iron core-box into an iron drying-shell, in which the threads lie open.

Another kind of cast thread is shown in Fig. 1.

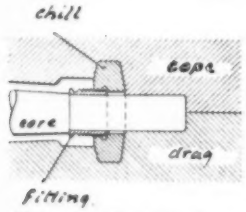

Fig. 3.—Casting-in a Fitting.

making the socket for a lamp. The round glass thread is very suitable for this purpose. The core has, however, to be made in an iron core-box without fins, which can easily be done, because it can be unscrewed. Another method utilises a nut as a chill, which is placed into the mould at the point where a plugged thread has to be cast, as shown in Fig. 2. In this case it is advisable to cast in the vertical position in order that the air is not entrapped in the threads causing an interruption in continuity. For the chill the standard thread has to be chosen because the shrinkage of the iron gives a sufficient play.

In such cases where the described method cannot be applied it is sometimes possible to machine the thread body cheaply and to cast it in. In casting the following points must be observed: (1) the specificated length of the thread must be preserved; (2) a flat bearing surface for the nut must be provided; and (3) the thread body must have a straight direction. A successful method, shown in Fig. 3, consists in securing the thread body into a steel chill and assembling both parts in the mould. In case the thread is likely to be damaged in cleaning the casting, the chill may remain on the casting during the cleaning operation. Parts of non-ferrous metals, such as brass, etc., cannot be cast in as their melting point is lower than that of the grey cast iron.

Sand-Cast Aluminium Alloys.

Mr. W. C. Devereux repeated his lecture on light alloys to the Sheffield Section of the Institution of British Foundrymen. Being an iron and steel centre, only a few points were brought out, which are given in the following abstract of the discussion.

DISCUSSION.

Mr. G. L. Oxley, who presided in the absence of the Branch-President (Mr. G. C. Castle), remarked that Mr. Devereux had gone into his subject very thoroughly, and although many of the audience were interested in cast iron, Mr. Devereux had made the lecture most interesting to them. In regard to what Mr. Devereux had said about sand and the need for a very weak sand, he had said that he used Mansfield sand. He (Mr. Oxley) always considered Mansfield a rather strong sand and would have thought that Worksop would have been better. He would like to know whether the lecturer melted his metals in crucible, high-frequency or electric furnaces.

Melting Furnaces for Aluminium.

Mr. Devereux said that Mansfield sand, used generally in aluminium, was used for the fine finish it gave to the castings. It was a strong sand, and that was why it was practically burnt before using. It was used with a very little addition of new sand, just to open it up. For the melting furnace either gas, oil or electricity was used in the aluminium industry. The electric furnace was undoubtedly the best form of furnace, but it had not yet reached the stage in aluminium work to be satisfactory. It was a difficult proposition with the inductance due to aluminium, and he did not know of any aluminium furnaces that were really successful for use in the sand-cast foundry. When the few difficulties still found in the electric furnace had been overcome it would undoubtedly be the best furnace owing to the absence of gas. The next best furnace was undoubtedly the oil furnace. In the gas furnace there was a tendency for the gas to get into the metal. A coke furnace was very good provided the coke was very well dried to remove all water from it.

Cracking in Castings.

Mr. C. Wood said that in regard to the temperature control, Mr. Devereux had stated that the "Y" and similar alloys should not be heated over 750 deg. C., yet later he gave the maximum of 850 deg. C. in the case of the R.R. 50 alloy. What was the reason for the difference of 100 deg.? Then the lecturer mentioned the question of starting, but he should think that there was a certain amount of sweating at the temperature stated. Concerning the question of cracks in castings, he himself had had some experience recently, and his results were nothing like as unfortunate as those that the lecturer had alluded to. At the same time he had considerable experience of cracking before the moulds could be opened. There was cracking in one or two different places. They tried to level up matters by casting from both ends and down the sides, but they never overcame the whole of the difficulty. They did not attempt to make the matter a case for investigation, but ultimately they made the casting they needed after having a considerable amount of scrap in getting it. He wondered if Mr. Devereux could give him some assistance as to what that might be caused by. In regard to cleansing, he would like to know if the lecturer had any means of fluxing and what he considered to be a satisfactory flux for the mixtures that had been described. He himself used zinc chloride, but he had learnt from many people that that was to be condemned. He did not know what the lecturer's experience in the matter was. He had read an article by a Japanese writer a little while ago, and the writer said that in Japan zinc chloride had been absolutely forbidden. Could Mr. Devereux enlighten them on that point?

Fluxes.

Mr. Devereux said that the actual figures he had given for the alloys referred to were 750 and 820 deg. C. As a matter of fact one should never reach the higher temperature. To reach 820 deg. C. one would not have to stew the material. He could safely say that there was no successful flux for the elimination of troubles with aluminium alloys. The fluxing must be a mixture such as zinc chloride or oxide mixture which would have a specific gravity that was much the same as the aluminium alloys. He thought the only safe way to clean the material was to use a good furnace and deliberately stew the material to a high temperature. The best flux he knew of was a mixture of the magnesium chlorides, but he used no flux whatever. He would not entertain the use of flux in the foundry at all. He believed the Government specifications in Japan included the elimination of zinc chloride. The reason for the objection to zinc chloride in Japan was accidents in the foundry due to putting on material that was wet or damp. The risk of accidents in most English foundries had been eliminated by the care with which the zinc chloride was stirred.

Regret was expressed by the Chairman and others at the small attendance at the meeting, and the lecturer voiced his own disappointment in this respect. Mr. Devereux was thanked for his address on the proposal of Mr. G. H. Cowen.

International Tube Syndicate.

As previously reported, the British members of the International Tube Syndicate have given notice to withdraw from the Syndicate at the end of this month. It is considered that the Syndicate has done good work in stabilising the market, and as the representatives of the British works are to participate in further negotiations, it is possible that an understanding will be reached before the lapse of the agreement.

The Scunthorpe Works Society has received a reply from Messrs. Richard Thomas & Company, Limited, in connection with an appeal made to them recently by the Society to reopen their Redbourn Works. These works, which are among the largest in the district, have operated for only about four years since 1920. Their resumption would make a great difference to Scunthorpe's unemployment problem, and it was in view of this that the Works Society made the appeal. In their reply, the company state that they will reopen their Redbourn works at the earliest possible moment, but the opening-up of these works while Continental steel is available at below production cost at Redbourn is impossible for them to contemplate. The company regret that they cannot give an indication of the reopening date, as the 10 per cent. protection recently granted has, up to date, not improved prospects. All that has happened is that the Continental manufacturers, including German, despite the adverse exchange, are willing to sell at the price which existed before the imposition of the 10 per cent. duty.

Modern Practice in Cast-Iron Testing.*

By H. W. Swift, M.A., D.Sc. (Eng.).

During recent years a great deal of attention has been devoted to the question of the testing of cast iron, concurrent with the general renaissance in iron-foundry practice which commenced during the war. British foundrymen have played a not inconsiderable part in this wave of development, and proof of the study they have given to the subject is found in the new B.E.S.A. (now B.S.I.) specifications, particularly that for general grey-iron castings, issued in 1928. Although a good many of the larger testing authorities still adhere to old methods, and although the specification is open to criticism in various matters of detail, there is reason to believe that it is attracting more serious attention from progressive ironfounders and engineers than when it was first issued.

But whether or not this specification ever becomes generally adopted, even its most ardent advocates cannot pretend that it achieves finality and settles once for all the difficult question of testing, which must inevitably become more complex with every step towards improvement and specialisation in foundry practice. Nor can it be claimed, without careful comparison, that the British specification is necessarily the only or the most satisfactory solution of the testing problem at the present time. It should therefore be a matter of more than ordinary interest to the British foundryman to inquire into the methods of testing which are adopted at the present time in other industrial countries, to examine them critically and compare them with his own standard procedure. Such an examination will show that there are several different methods of approach to the testing problem for which strong arguments can be put forward, and even if all other methods are found wanting by comparison with our own practice, the British foundryman will at least have increased his own confidence in the B.E.S.A. (B.S.I.) specification.

In this Paper it is therefore proposed to undertake a brief survey of the testing methods in use in this and other countries, notably France, Germany and America, and to see what lessons can be learnt from a critical comparison. It is important to point out at the outset that the methods described here are not necessarily methods which are universally employed in the countries referred to, any more than the B.E.S.A. (B.S.I.) bars are universally employed in this country; rather should the methods be regarded as representative of the practice of the more progressive testing authorities and as indicating the consensus of enlightened foundry opinion in the country concerned.

Table I.—*B.E.S.A. (B.S.I.) Specifications.*

Key.	Thickness of casting.	Transverse bar. Cast dia.	Transverse bar. Modulus of rupture. Grade A.	Transverse bar. Modulus of rupture. Grade C.	Tensile test. Turned dia.	Tensile test. Tensile strength. Grade A.	Tensile test. Tensile strength. Grade C.
S	< ¾	0.875	24.2	19.6	0.564	12	10
M	¾—2	1.2	23.1	18.9	0.798	11	9
L	> 2	2.2	19.2	17.2	1.785	10	9

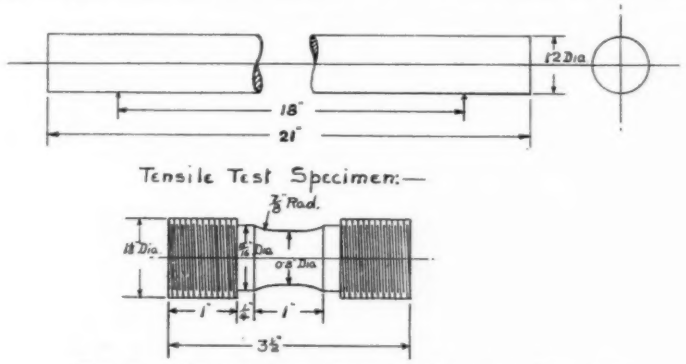

Fig. 1.—The American Standard Tests for Cast Iron.
(The upper sketch is the Arbitration Bar and the lower the tensile test-piece.)

Table II.—*American Standard Tests for Cast Iron (Arbitration Bar).*

		Class of Casting. Light.	Medium.	Heavy.
Ordinary grade—				
Transverse load	lbs.	1,500	1,750	2,000
Deflection ..	in.	0.20	0.20	0.20
Tensile strength	lbs./sq. in.	18,000	21,000	24,000
High-Test—				All Classes.
Transverse load			lbs.	2,250
Deflection			in.	0.24
Tensile strength			lbs./sq. in.	28,000

Classification.

Light castings: having any section < ½ in. thick.
Heavy castings: having no section < 2 in. thick.
Medium castings: not included in either above.

British Standards.

To commence the survey at home, the traditional British test for cast iron is, of course, the transverse test. This has been employed from the earliest days of industrial expansion; it was the obvious form of test in days when cast iron was commonly used for beams, and its long life has been largely due to the simplicity of the test and of the machine employed. The traditional British test-bars are the 1-in. square section tested over a span of 12 in. and the 2-in. by 1-in. rectangular bar tested over 36 in. Both are still used by important bodies, the larger bar being, in fact, standardised for cast-iron pipes. As a rule, these bars have been separately cast.

The B.E.S.A. (B.S.I.) specification for general grey-iron castings issued in 1928 allows for transverse and/or tensile tests at the discretion of the purchaser, and empowers him to have the test-bars cast on where practicable, though the arrangement of the mould is left to the discretion of the foundryman. This specification, so far as the author is aware, was the first officially promulgated specification in which the cross-section of the test-bar was made dependent on the dimensions of the casting it was intended to represent. There are three standard round bars, S,M,L, corresponding to the ranges of "mean cross-sectional thickness" indicated in Table I. The bars are subjected to transverse test without machining, and minimum values for the breaking load and deflection are both specified for two grades of iron: Grade A and Grade C. The tensile test-bars are machined from the broken ends of the transverse bars, to dimensions shown in the table, and the specified tensile strength varies with the size of test-bar and grade of iron.

It will be noted that this specification recognises three mechanical qualifications for cast iron; its tensile strength, its transverse strength and its deflection under transverse loading. It also recognises in principle the effect of the rate of cooling on the mechanical properties, by the adoption of three standard bars, though it does not profess to carry this recognition to its logical conclusion, for according to Pearce the ¾-in. bar was chosen as the smallest which it is satisfactory to cast, the 2.2-in. bar as the largest it is easy to test, and the 1.2-in. bar in order to fall in line with the agreement reached by the International Association for Testing Materials in 1913.

American Standards.

In America the traditional test has again been the transverse test, and there has existed the same diversity of test-bars as in this country. The 1-in. square bar tested over 12 in., and the 2-in. by 1-in. bar tested over 24 in., were among the most popular until the famous "Arbitration Bar," 1¼-in. dia., tested over a 12-in. span, was introduced by Walter Wood in 1903. This arbitration bar has recently been modified as a step towards international agreement and has now the same dimensions as the British mediuni test-bar: 1.2 in. dia. tested over a span of 18 in.

The bar is cast separately in a vertical dry-sand mould. The transverse test is carried out on the rough bar, both load and deflection being specified. Tensile bars are prepared from the ends of the transverse bar in much the same way as the British, but the form of tensile pieces is quite different, being considerably shorter, as indicated in Fig. 1. Table II shows the specified strengths and deflections. It will be noticed that two grades of iron are recognised; ordinary and high-test. It will also be seen that some attempt is made to recognise the principle of the rate of cooling, though in quite a different manner from our own specification. Instead of using different test-bars for different thicknesses of casting, a single test-bar is used with different test requirements according to the thickness represented. Owing to these differences it is not easy to compare the British and American tests at all closely, but it will be noticed that the American deflection requirements are considerably greater than those for the corresponding British bar.

German Tests.

The traditional German test-bar is a round bar 1.2-in. dia. subjected to transverse test over a length of 24 in. between supports. This bar has almost the same section as the American bar but is considerably longer. It is cast in a separate mould and is tested in the rough, both breaking load and deflection being specified. This bar is still firmly established as the stan-

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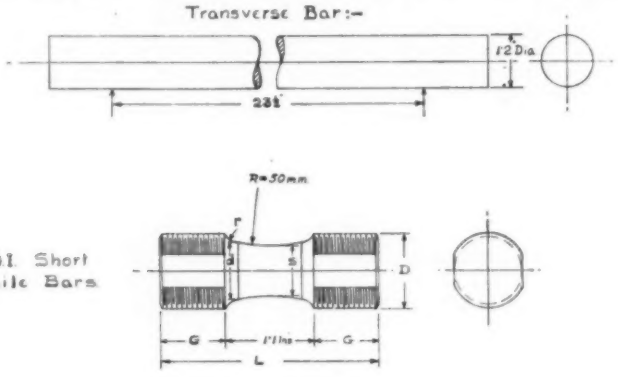
* A Paper read before the West Riding of Yorkshire Branch of the Institute of British Foundrymen, Mr. A. S. Worcester presiding.

dard, and no serious attempt seems to have been made to recognise the mass effect so far as the transverse test is concerned.

But this principle is clearly recognised in the specification for tensile tests which has been advocated recently by the V.D.I. and other German testing authorities. The bars for these tensile tests are short and their diameter is specified according to the mean wall thickness of the casting, the bars being either cast-on to the casting or taken from a sampling flange in such a way that the root diameter of the screwed ends is equal to the representative casting thickness. At present the range of sizes is rather numerous, as will be seen from Fig. 2, but it is apparently intended to reduce this number later if it is found desirable.



s		Dimensions in mm				
ins	m.m.	D	G	d	r	L
·24	6	10	12	7	1	52
·32	8	12	15	9	1·5	58
·39	10	16	19	13	1·5	66
·47	12	18	22	14	1·5	72
·55	14	22	26	17	2	80
·67	17	24	29	19	2	86
·79	20	27	32	22	2	92
·90	23	33	40	26	3	108
1·06	27	39	47	32	3	122
1·26	32	45	54	37	4	136
1·50	38	52	62	43	4	162

Fig. 2.—The German Official Standard Test-Piece Dimensions.

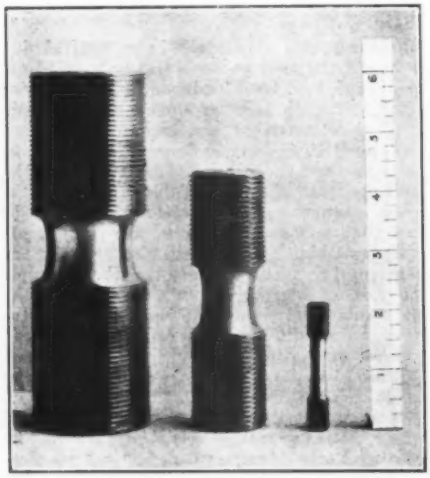


Fig. 3.—The Largest and Smallest and an Intermediate Size of the German Official Tensile Standards.

The general shape of the tensile test-pieces will be seen from Fig. 3, which shows the largest and smallest and an intermediate size. They are essentially short test-pieces and so correspond more nearly to American than British practice, but they differ from the American tensile bar in having no parallel gauge length whatever, the central portion being machined to a circular profile.

In addition to the transverse and tensile tests, which seem to be generally accepted all over Germany, a number of other forms of tests have been proposed by testing and foundry authorities in various parts of the country. These tests include the ordinary Brinell ball-hardness test, using a 10-mm. ball and a load of 3,000 kg., the Charpy impact test on specimens 8 by 10 by 80-mm. span, either with or without notch, taken from fractured bend test-bars, and a number of suggested forms of shearing test.

These shearing tests are of more than ordinary interest, because there is a very considerable body of instructed opinion on the Continent which regards the shear test as more valuable and informative than the tensile test on cast iron, a point of view which is little known and still less appreciated in this country. The forms of shear test, more closely associated with German practice, are punch tests, in which the central core is punched out of a turned specimen or disc. The form of specimen has been the subject of much discussion and research, for which credit is mainly due to Karl Sipp and Rudeloff.

A test-piece, of the type proposed by Sipp in 1920, is shown in Fig. 4. It was intended that it should be machined from a special boss on the casting. The collar rests on a hardened shearing ring, and pressure is applied on the upper face until the collar is sheared through. As an outcome of a considerable research, Rudeloff modified this specimen, as shown in Fig. 5, so that the flange was only 0.06 in. thick and 0.04 in. wide, with three radial saw-cuts to reduce the chance of parasitic stresses. Later Rudeloff has proposed to replace this rather elaborate specimen by a plain turned disc, about 1 in. dia. and $\frac{1}{15}$ in. thick, with three radial saw-cuts, as indicated in Fig. 5. At the present time attention seems to have been directed rather away from the punch test to the pin-shear test, which consists in shearing through a cylindrical rod usually obtained by trepanning the casting. This is an adaptation of the Frémont shear test, to which reference is made below, but with larger-sized pins than are used in France. An idea of the sizes of the Sipp-Rudeloff and Rudeloff specimens is given in Fig. 6, where they are shown with a standard 1-in. gauge.

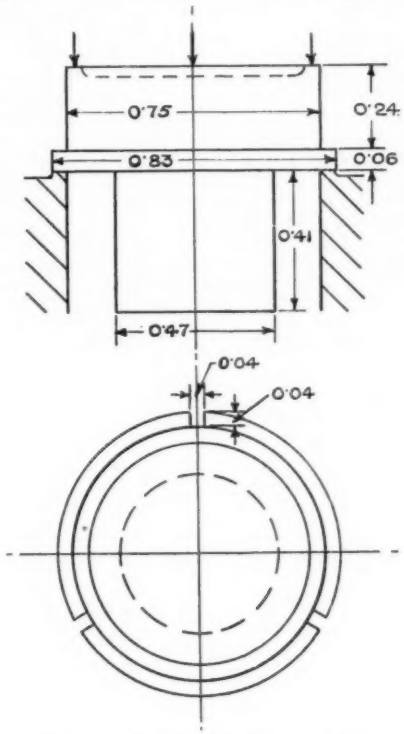


Fig. 4.—The Sipp-Rudeloff Shear Test Specimen.

French Tests.

France appears to have been the original home of the transverse test, for the so-called Monge test was in use as early as 1790 at the famous Creusot Foundry, being applied to a cantilever of 3½-in. sq. section, 20 in. long. Eventually the Monge tests were superseded in France by tensile tests and impact tests, the tensile tests being commonly made on bars ¾ in.

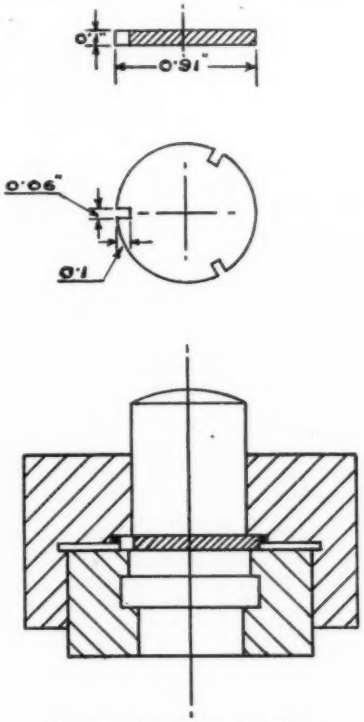


Fig. 5.—The Rudeloff Disc.

or 1 in. dia. The impact test was carried out on a bar 1½-in. sq. section, 6¾ in. between supports, a load of 26½ lbs. being dropped on to it from successively greater heights until the bar failed or the particular specification was satisfied. Both these tests were normally made on separately cast bars. The Charpy form of impact test was also in considerable use on bars 0.4 in. sq., with just over 2 in. between supports.

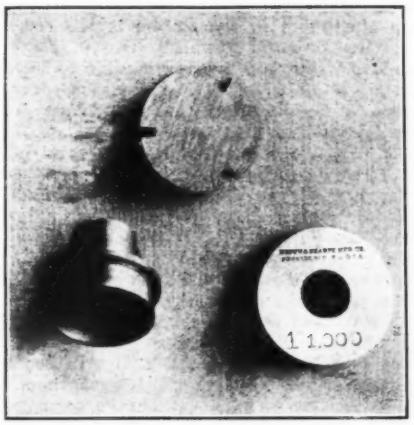


Fig. 6.—Showing the Sipp and Sipp-Rudeloff Specimens at the Side of a 1-in. Gauge.

In recent years there has been in France a very significant reaction against these tensile and impact tests, and a movement to replace them by transverse and shear tests made on test-pieces of a size which could be taken from the casting itself, and by Brinell hardness tests. This has been an essentially French development, and has been due notably to the work and advocacy of Frémont, Portevin, Ronceray, le Thomas and Guillery.

In 1912 Frémont introduced his famous transverse and shear tests. The transverse specimen was about 0.32 by 0.4 in. section, tested over a span of 1.2 in. The shear specimen was $\frac{1}{25}$ sq. in. in section, either square or circular, and about 0.8 in. long. The circular specimen was cut from the casting under test by means of a hollow drill or trepanning tool, released by means of a special double sleeve with an eccentric action, and tested without subsequent machining in a shearing machine of the lever type, tests being made every ¼ in. along the specimen until it became too short to hold. The Frémont specimens are shown in Fig. 7, with a 1-in. gauge for comparison.

The original apparatus used by Frémont was rather crude, and subsequent designs have been considerably improved, but the size of test-pieces and general methods of test remain unaltered. One of the best-known machines employed at the present time is the Guillery machine, which is essentially a ball hardness-testing machine, with attachments to adapt it for the Frémont transverse and Frémont shear tests. One of the arguments in favour of the French system of testing is the fact that a single machine can be employed to carry out all three forms of test.

Specifications based on the Frémont tests have been adopted by the French Marine and important railway and other authorities in France and Spain. Details have been published by le Thomas and Bois of a complete specification of this kind, which will give a good idea of recent French practice. Tests are specified up to five in number, depending on the grade and size of casting. Of these the first two are shear tests, the next one transverse and any remainder shear tests, with the provision that if necessary, through lack of equipment, an equal number of compressive or transverse tests may be accepted in place of the shear tests. The requirements for various grades of iron are shown in Table III. It will be realised that since the test-pieces are taken from representative points on the casting itself the question of mass effect is already involved and does not arise as a separate problem.

(To be continued.)

Table III.—*French Specification Based on Frémont Tests.*

Class of cast iron.	Shear, tons per sq. in.	Transverse tests.		Brinell No.	Compression, tons per sq. in.
		Load, lbs.	Deflection, in.		
Extra strong ..	15.9	1,210	0.012	170—240	50
Strong	12.7	990	0.010	150—240	40
Ordinary	9.5	770	—	130—240	30

Fig. 7.—The Frémont Specimens shown with a 1-in. Gauge for Size Comparison.

Catalogue Received.

Geared Motors.—The publicity sent out by Crofts (Engineers), Limited, Thornbury, Bradford, is always devoid of any showmanship, yet, for all that, we know of little publicity matter more cherished by the engineer buyer than that issued from this house. The reason probably lies in the fact that the firm makes useful material, illustrates and prices it, and then backs it up by a stock from which, by experience, one knows one can draw and get delivery with the shortest possible delay. This new catalogue covers a wide range of integrally-geared motors, and standardisation has been achieved from 0.05 to 3½ h.p., with speed ratios up to as high as 60:1, giving shaft-speed outputs from 12 to 400 r.p.m. The data given are as comprehensive as any engineer could wish for. We are certain that this 24-page well-illustrated catalogue will survive more spring-cleaning rejections than 90 per cent. of those contained in the modern works catalogue library.

An electrical stator, weighing 110 tons, was transported recently by the L.N.E.R. from the Heaton works of Messrs. C. A. Parsons & Company, Limited, to the Dunston power station of the Newcastle Electric Supply Company. The stator was slung between two 70-ton wagons.

American Foundrymen's Association Convention.

CHANGED VENUE.

The Board of Directors of the American Foundrymen's Association announce that the next Annual Convention of the Association will be held at the Hotel Statler, Detroit, on May 3, 4 and 5, 1932. This announcement supersedes our previous announcement that the Annual Convention and Exhibition would be held in Philadelphia from May 2 to 6.

The Convention at Detroit will be similar in character to the very successful annual technical and business meeting held at the Edgewater Beach Hotel, Chicago, in 1927, and will be the second time since 1905 that an annual meeting has been held without commercial exhibits.

The Association also announces that the splendid facilities afforded by the new Convention Hall in Philadelphia have been reserved for the spring of 1933. It is expected that all allied associations and societies which had contemplated meeting jointly with the Association in Philadelphia will announce that their meetings will be held during the days of the convention in Detroit.

The Programme and Papers Committee of the Association has been unusually fortunate this year in having a wealth of good Papers from which to select in organising its programme. These sessions, together with those of other organisations meeting jointly with the Association at that time, will provide such a concentrated meeting as will enable foundry managers, engineers, metallurgists and shopmen to get the most value for a minimum of expense and time.

TENTATIVE PROGRAMME.

Tuesday, May 3.—9 a.m., Sand Shop Course; 10 a.m., Steel Founding; 10 a.m., Non-Ferrous Founding; 12.30 p.m., Non-Ferrous Round Table; 12.30 p.m., Steel Round Table; 4 p.m., Shop Courses; 8 p.m., Sand Control.

Wednesday, May 4.—9 a.m., Sand Shop Course; 10 a.m., Steel Founding; 10 a.m., Grey-Iron Founding; 12.30 p.m., Pattern-Production Round Table; 2 p.m., Apprentice Training; 4 p.m., Shop Courses.

Thursday, May 5.—9 a.m., Sand Shop Course; 10 a.m., Grey-Iron Founding; 10 a.m., Malleable Founding; 12.30 p.m., Malleable Round Table; 2 p.m., Materials Handling (A.S.N.E. co-operating); 3 p.m., Business Meeting; 4 p.m., Shop Courses.

Iron and Steel Production.

The National Federation of Iron and Steel Manufacturers, in their Statistical Bulletin for January, point out that production of pig-iron and steel in January was at practically the same level as in December, the production of pig-iron being 330,000 tons compared with 330,600 in December, and steel production rising slightly to 429,700 tons compared with 425,400 tons in December.

The number of blast furnaces in operation increased by six during the month to 76, but two of these are small furnaces on special irons which will not contribute substantially to the output of pig-iron.

According to the returns from 142 firms employing 81,740 workpeople, the average weekly earning in December per head amounted to £2 14s. 1d. compared with £2 16s. 5d. in November and £2 15s. 7d. in October, 1930.

Bridges erected by Messrs. Dorman, Long & Company, Limited, in various parts of the world during recent years were described by Mr. J. Walton, of the firm's bridge constructional department, in a lecture at the Cleveland Scientific and Technical Institute, Middlesbrough, on March 3.

The Production of Ferrous and Non-Ferrous Castings for High-Class Internal Combustion Engines.*

By S. White (Sandiacre).

In writing this Paper the author does not attempt to enumerate any hard or fast rule for the production of castings coming within the above category, but has tried to describe methods which have proved to be uniformly successful over a period of more than 30 years.

The moulding sands used were Lenton sand for all green-sand work, excepting the very lightest, which were made in Mansfield sand. Lenton sand was also used for all dry-sand loam and core sand. Mansfield sand was used for all non-ferrous castings, and Dale yellow sand for all heavy loam jobs such as flywheels of 18 tons and over. The opening medium for dry sand and core sand was sawdust.

The old method of making cylinder cores was as follows:—The body core was struck up in loam on a barrel, with a spigot on the bottom which located the head core carrying the admission and exhaust cores. Some 30 years ago the patterns were re-made and the joint line was carried through the centre of the admission and exhaust cores. This alteration allowed the cores to be made in a half core-box and also enabled the runners to be placed through the body core, and that method of pouring cylinders is still in use. The liners and piston-ring blocks were invariably poured through a number of small downgates placed round the circumference of the casting. Pistons were run through the body core. Here, again, the patterns were re-made some years ago. The old method of moulding them horizontally was discarded and the patterns made to mould vertically. These patterns carried a taper core print for the body core and special moulding boxes were made for the job. The boxes were machined with a taper in the upper flange of the moulding box corresponding with the core-print taper, which automatically located the core in position in the mould. A rather novel feature of this job was the fact that no top part was used, the runner box acting as a top part. This was achieved as follows:—The runner box was of the usual coffin shape with a flange either side, in which were drilled holes to fit pins carried in the moulding-box flange. The pins were slotted for cottering and the whole box formed a neat and reliable job. In passing, the golden rule in casting cylinders, pistons and liners is—pour them as hot as possible, as one only courts failure with dull metal.

Flywheels up to 4 tons were made in green sand from plate patterns. Over that weight and up to about 12 tons, they were made in loam sand from half or quarter patterns, located on a large faceplate by means of dowels. This method represented a great saving in pattern-making and moulding over the old system of striking them up in loam. All flywheels were invariably poured through the boss and a riser of generous size was placed on the rim, through which the wheel was fed. Stoppers were used on downgates for all classes of work except very small castings. With the exception of the castings dealt with, all other jobs such as bedplates, water jackets, etc., were run as near the bottom as possible, and the consistent good results obtained proved this system to be good practice.

The various irons normally used consisted of the special cylinder irons for the cylinders, pistons, piston-ring blocks, combustion chambers, etc., and close Derbyshire brands for the other castings.

Defect Due to Cuprous Oxide.

In connection with the non-ferrous side the author would like to recall a curious incident that occurred some 28 years ago. A number of main-bearing castings were made and to all appearances were perfectly sound, but proved quite the reverse. On machining they were found to be literally metallic sponges and the deeper they were machined the worse they became. In the interior of the small holes what appeared to be rust was found. The defect was at first thought to be caused by the metal having been stewed in the furnace, but on analysing the trouble was traced to the presence of cuprous oxide, and this excess of cuprous oxide was also traced to scrap copper wire which had been used for high-tension electric current. The moral in that case seemed to be "use virgin metal," but here lies the snag. Some six years ago the brassfounder went to the author with an incident of exactly the same trouble, but in that case virgin metals were used exclusively. It may be said here that no amount of re-melting would clear the affected metal, unless something was done to create the necessary reaction. This could be done by the addition of phosphor tin in the proportion of 6 ozs. to each 100 lbs. of affected metal, and that was the only practical method known to the author.

Non-Ferrous Mixtures.

The mixture used for all bearings in gunmetal was: Copper 18 lbs.; tin 1½ lbs. and zinc 4 ozs. Phosphor-bronze, which proved excellent in use, was made up of: Copper 18 lbs.; tin, according to the purpose for which required, and phosphor-tin 10 ozs. to the 100 lbs. of metal. An anti-friction metal which will stand up to severe duties is composed of: Tin 43½ lbs.; antimony 4 lbs. and copper 2½ lbs. In making up this metal the copper is melted first, then the antimony added and lastly the tin. Great care should be taken not to overheat this metal, as its properties are likely to be impaired.

DISCUSSION.

Mr. Peace (Derby) asked whether Mr. White would explain the method of stripping the larger flywheel castings.

Mr. White said the wheels were left until practically cold before stripping was commenced. There was no baring of sections of the wheel to facilitate cooling.

Mr. Lucas asked for further information on the methods of mixing the non-ferrous metals.

Mr. White said phosphor-tin should not be added to the ladle until the pot was lifted from the fire. Tin also should be added after the pot was off the fire.

Mr. S. H. Russell (Past-President of the Institute) asked for further details of the methods of running the castings through the cores, and also how flywheels were made from a quarter pattern on a faceplate.

Mr. White illustrated the runners by blackboard sketches, and Mr. Russell asked how one could break out the runner from the bottom of the cylinder casting.

Mr. White pointed out that it was possible to reach the runner for fettling purposes through the exhaust-port cores. On the question of the quarter flywheel pattern Mr. Russell could not quite understand the procedure, as the blackboard sketch showed a semi-circular pattern and not a quarter segment.

Mr. White replied that the pattern was half the diameter of the wheel and half the depth of the wheel, thus making a quartern pattern, and Mr. Russell said that it was now quite clear. He would not refer to that as a quarter pattern, but half of a half pattern.

Mr. Driver asked whether any special provision was made to prevent sand washing when running the cylinders through the core.

Mr. White replied that there was no special provision. The cores were made in the ordinary dry-sand mixture, and gave no trouble.

Mr. H. Bunting asked whether Mr. White could give him any idea as to what was the best way to prevent separation in aluminium-bronze. He had a case that showed a large proportion of pure aluminium in the bottom of the castings. Referring to large flywheels, run in the boss, had Mr. White had any trouble due to segregation on the rim? He had experienced segregation, especially where the runner box came over a portion of the rim.

Mr. White said all flywheels were run in the boss. The wheels were machined all over the top and bottom of the wheel rims, and he had not been troubled with segregation. The runner box might have some effect if the metal was left in the box, but his riser on the rim was of the run-off type so that the runner box was drained. He had always run the castings in the boss, and had never tried any other method. The main idea is to get equal cooling and to run flywheels in the heavy section is wrong. Running in the boss facilitated equal cooling. The strength of the wheel does not mainly bear on the composition of the metal. The contraction of the arms has a lot to do with it, and he thought to run wheels in the arms was asking for trouble. The trouble with aluminium-bronze was due to bad mixing. It was hopeless to try to produce that alloy direct from the first mix. It must be made into ingots and then re-melted.

Feeding Flywheels.

Mr. Stevenson asked whether Mr. White fed bosses of flywheels, and on receiving a negative reply asked for the analysis of the metal.

Mr. White said he was not able to give analysis figures; the metal was judged mainly from fracture.

Mr. Butters referred to Mr. White's statement of feeding the rim, and his later statement that the riser was of the run-off type and asked how the feeding was effected.

Mr. White replied that after the wheel was cast the riser was made up into a bush and re-filled with metal for feeding purposes.

Mr. Hallamore, referring to the running of pistons through the core, asked for the depth on the runner.

Mr. White: Up to 2 ft. 6 in. in the larger sizes of gas-engine piston.

Mr. Driver asked what provision was made for venting in the special box parts for the pistons.

Mr. White said he had a few holes drilled in the sides of the boxes.

Mr. Stevenson asked whether Mr. White had any experience in making the exhaust-valve stems in cast iron or steel-mix cast iron. He was under the impression that they should be in steel, but had recently had one to make for a replacement job.

Mr. White, agreeing, said it was common practice to make the valve stems in cast iron.

Mr. Lucas, referring to the mixtures given for the non-ferrous metals, asked what was the correct amount of tin for a hard phosphor-bronze, and whether it was re-melting.

Mr. White gave 2½ lbs. tin to 18 lbs. of copper as being suitable when asked whether phosphor-bronze was re-melted direct from the original mix.

Cause of Pinholes.

Mr. S. H. Russell referred to the pinholes in non-ferrous due to cuprous oxide. Non-ferrous metals were a very intriguing subject, and anyone interested could not do better than look up the Papers by the late Mr. H. C. Dews. Mr. Dews, whose most regrettable death was just announced, had done a quantity of important work on the non-ferrous side. The pinhole trouble he thought due to oxidation of the metal. As long as the copper was deoxidised before pour-

(*Concluded on page* 179.)

* A Paper read before a meeting of the East Midlands Branch of the Institute of British Foundrymen at Loughborough, Mr. T. Spiers presiding.

The Modern Blast Furnace.

By Geo. E. Butler, F.C.S., A.M.I.Chem.E.

(*Concluded from page* 145.)

Fitting of Hearth Jackets.

Great care must be exercised in fitting the straps round the bolted hearth segments to make these perfectly rigid. A good brick of low-expansion coefficient should be used; silico-aluminous bricks with an expansion coefficient below ½ per cent. are now obtainable. Carbon bricks, now widely used in Germany, are equally suitable, having practically no coefficient of expansion. A long opening is provided in this type of jacket at the taphole about 24 to 32 in. high and 16 to 20 in. wide, strengthened by a strong single-piece casting completely surrounding the hole. This covers any variations in the position of the taphole, these being very small where a distance of 8 to 10 ft. is provided between the hearth level and the tuyeres.

The importance of seeing that every detail in design fits in with the whole is well exemplified by this type of taphole construction. It would result in serious trouble if used on a furnace of small hearth diameter, with a flat bosh angle of 70 to 72 deg., and with only 5½ ft. between hearth level and tuyeres, in fact, a furnace prone to hanging.

The taphole in this case has to be lifted when a fall of scaffold occurs, since the hearth becomes rapidly choked. Further, the hearth bottom, if too close to the tuyeres, is scoured out by the downward action of the blast, until this distance reaches down to the 8 ft., with which it should have been provided in the first place, with the result that, after less than a year's blowing, the taphole has to be taken down 2 or 3 ft. If falls of scaffold take place, the hole has again to be lifted. It is readily seen that, in such a case, a jacket insufficiently open at the taphole would cause almost insurmountable difficulties.

The mud gun becomes an absolute necessity if the newer type of jacket is installed. In such a case it is no use trying to stop the forepart by hand, since it is impossible to reach and renew the shoulders; to do so means using a wide opening, resulting in insufficiently cooled shoulders and liability to break-outs. In some cases designers have provided a massive truncated iron jacket, 4½ in. thick, in segments, fastened together by kidney hoops, and surface cooled externally by water sprays; this type is in use at the new Mannesman plant at Uckingen.

This massive iron segmental jacket has been replaced, at some German plants, by a continuous jacket of 2- to 4-in. steel plates. The 1,100-ton furnaces at the Gutehoffnungshütte works at Oberhausen, and again at the Dortmund Union plant are provided with truncated jackets, consisting of two mild-steel plates placed together, each 1 in. thick; the same construction is used on the 700-ton Hoerde furnaces, where the plates are each 2 in. thick. Hearth-jacket construction has evolved towards the massive jacket, made of cast iron, cast steel, or juxtaposed steel plates, of great strength and capable of standing up to the thrust liable to come against it due to the expansion of the bricks and to the opening of the brick joints.

The opening out of the brick joints was due to the expansion of the jacket, and was undoubtedly the chief cause of the breakouts in the older furnaces. It was found that the only effective type of jacket was of the massive construction previously mentioned, coupled with intensive cooling. Efficient water supply is vital to the intensively worked furnace, being essential for keeping all parts of the furnace in good order—this applies particularly to the hearth. Here the water used on the jacket should be nearly as cold on leaving as on entering. Such a furnace requires a very large amount of water, this being approximately 200,000 galls. per hr. on the 1,000-ton per day furnace; of this quantity the hearth jacket alone requires more than half.

Furnace Columns.

In order to leave as much space as possible round the hearth and bosh, the columns of these large furnaces are splayed; this is essential on the American furnace in which a plate shell is used, entirely surrounding the shaft and bearing directly on the tops of the columns through the intermediary of a lintel ring which carries the whole weight of the shaft. This type of construction has been followed by many Continental plants, including Dudelange, Uckingen and Ijmuiden, instead of the usual Continental construction in which an independent outside framework is used to carry the top structure, owing to the shaft being surrounded by straps instead of the complete casing with which we are familiar.

The tops of the columns are joined by a ring of 1½-in. steel plates, on to which, by means of strong angles, is fastened the shaft shell. The bottom of the shell, in order to obtain sufficient stiffness, is made of ¾-in. thick steel plates, acting as the web of an ideal circular column whose bottom flange is formed by the lintel ring supported by the columns. A light stiff column, capable of supporting the shaft and top gear, is thus obtained.

The foundations for the columns are placed 8 ft. below the taphole at the same level as the bottom of the hearth jacket; the foundation consists of a cast-iron segmental ring, rigidly bolted together and externally hooped, to which the splayed column bases are fastened. This foundation ring is further surrounded by a ring of reinforced concrete as a further precaution against sliding of the column bases due to their horizontal thrust.

Unsymmetrical placing of columns and tuyeres is rarely to be found on the modern furnace, the tuyeres being set midway between the columns. The position of the columns is such that they leave each tuyere perfectly clear and do not hinder rapid work when required at the tuyeres.

Ten tuyeres are usually provided on the 1,000-ton Continental furnace, but instead of ten columns, the theoretical number required, only eight are used, when the slag notch is situated diametrically opposite the taphole, the two columns corresponding to the taphole and notch are left out. In cases where the notch cannot be placed opposite the taphole owing to slag road lay-out, it is placed under one of the lateral tuyeres and nine columns are used. Some furnaces are provided with twelve tuyeres, and in such cases only six columns are used and the tuyeres are arranged symmetrically between the columns in pairs. As a result of such column positioning, a furnace which is very clear of encumbrance round the forepart is obtained.

Tuyere Housing, Tuyeres and Bosh.

Above the hearth jacket is provided a continuous steel-plate belt, 1½ to 1¾ in. thick, which is pierced with circular openings for the tuyere and slag-notch openings, and strengthened at these points by extra thicknesses of steel plate. All joints are double-butted and double-riveted. Long openings are also provided in this belt for the various copper cooling plates, the hoses of which penetrate to 4 in. from the inner hearth wall.

To house the tuyeres in this belt a short steel casting is used, tapering towards the inside and rigidly held by cotter bolts. This fits into each tuyere opening, and into these are fitted the bonnets, the noses of which reach to within 8 in. of the inside of the hearth wall. The bonnets receive the tuyeres, which vary in length from 10 to 12 in. Perfect blast-tight joints are made, even at pressure of 30 lbs. per sq. in., between the tuyere and bonnet, and bonnet and housing, which in each case overlap about 4 in., by accurately machining, on each, two fitting strips ⅜ in. wide.

Tuyeres are now being used on the Continent made of "laminated" copper, fabricated from the solid block, not cast. These tuyeres are giving most remarkable results. There is a case on record of one having a life of fourteen months in a furnace producing 775 tons per day. That is, it was in the furnace during the production of 328,000 tons of iron.

The bosh is either well supported by straps, in which case it is cooled by the insertion of copper cooling plates, or covered with a truncated jacket of strong steel plate, when it is cooled by exterior surface spraying. The steel-plate bosh is usually found at plants which have adopted the steel-plate hearth jacket.

Shaft Shell and Belts.

There is a marked difference between the shaft construction adopted in America and that in vogue on the Continent. As already stated, the Americans completely cover the shaft with a steel-plate shell resting on the lintel ring. This carries the weight of the top structure and sometimes also the skip bridge. Most Continental operators contend that this type of construction has the great disadvantage that the shaft brickwork cannot be kept under observation, and that, in cases of very extended local wear, when a patch might have been put in, a complete relining is compulsory.

The shaft being the weak point in high-production furnaces, most Continental operators are concerned about the question of shaft wear. They consider it is preferable to be organised to carry out rapid and compulsory cheap repairs than to proceed to blow out and carry out a complete relining. The shaft, at one French plant, has to be relined every two years, over a height of 16½ ft. in a zone right round the furnace from about 20 ft. to 35 ft. above the tuyeres, and this repair is carried out in two or three Sunday stoppages so as not to upset the running of the steel plant. Such a repair could not easily be attempted with a steel-plate shell construction.

Special devices are also used at the Cockerill Works at Seraing in their shaft construction, to facilitate and speed up repairs. Their design consists of a rigid self-supporting shell, made up of a large number of metallic hoops divided into eight sections and fastened to eight upright members. In the case of one of their furnaces the entire shaft was rebuilt as new in eight days; this could not have been done under four to five months by blowing out in the usual way.

The usual Continental practice is, therefore, only to jacket with a steel-plate shell not more than the bottom 8 ft. of the shaft, the rest of the shaft being supported by straps, the top gear being separately supported on a column structure. The shaft brickwork is also carried upon the lintel independently of the bosh, and provision is made so that the bosh can expand vertically without disturbing the shaft. There being no continuous casing the shaft depends for its stability upon the brickwork, so that great care has to be taken that no extraneous loads come upon it.

Very substantial columns are used to support the mild-steel lintel carrying the shaft brickwork. Internal stress in the shaft is taken up by mild-steel bands binding each alternate two courses of brick, each double course of bricks projecting ½ in. or so beyond the double course of bricks above, so as to form a ledge for vertical

support of the bands. This construction involves the use of independent supports to carry the top structure, top gear, etc., which must not be supported by the shaft; these supports consist of steel-lattice columns the full height of the furnace, and these carry the loads which in the American construction are taken up by the shaft casing. The top ring is, in effect, part of the top structure, as it is not directly attached to the shaft, but makes connection with it by means of a sand seal in order to ensure complete freedom for expansion or to take up any movement due to settlement. This type of construction, however, requires considerably more steelwork than in the American design.

Despite the contentions of the Continental operators, the American practice is to blow out and reline after a campaign of about 1½ million tons production. The American construction has, however, been adopted at Dudelange in Luxemburg, and at the new Mannesman plant at Uckingen, as being economical and practical, and also because the McKee skip-charging system has been installed. This did not require any special supporting framework such as is required to support the top structure of the usual Continental furnace.

Improvements in Shaft Belt Construction.

The type of belt system for the shaft generally used in Continental practice has, however, the disadvantage that, when repairs to the shaft are necessary, the simultaneous removal of several bands may bring about the collapse of a large portion of the brickwork, especially when the lining has worn very thin in places. The contention of Continental operators that it is advisable to be able to carry out repairs to the shaft during the campaign of the furnace has led to close study of shaft-belt construction. This has led to a newer type of construction in which main upright members are used, acting as binders between the different segments of the belt, the arrangement being such that several segments of the belts forming part of a panel between two adjacent main members can be dismantled without in any way disturbing the rigidity of the whole.

The main upright members consist of a roughly-formed or cobble channel, or cast-steel channel, with 1¾- to 2¼-in. flanges, and 18- to 20-in. webs, so as to have great lateral stiffness. Holes are cut in these flanges, through which are passed the ends of the belt segments; in this way a very rigid conical cage is obtained, against which the brickwork is built.

Further improvements in shaft-belt construction have since been carried out at the Ougrée Marihaye works. Here, large flats, built into the brickwork, are used as main upright members, to which pieces of cobble channels are riveted at the requisite distances apart of the belts. Rectangular holes are cut at each end of the two flanges of these channels, and in these holes are fitted gib cotters, the aim of which is to receive and distribute on to the flanges the strains imposed by the belt segments. The ends of the belt segments are, therefore, looped round and butt against the end cotter, and the belt is well tightened by driving a wedge cotter in between the looped belt end and the far gib cotter. When repairs are undertaken, dismantling of the necessary belt segments is easily carried out as only the wedge cotter requires to be knocked out.

Shaft-Cooling Plates.

The shaft at most German plants is cooled by the insertion of a large number of cast-iron cooling plates, either open or closed. This, it is claimed, lengthens the life of the shaft by protecting it against very rapid wear. These cooling plates require to be kept under regular observation, and to be systematically cleaned. Continental opinion with regard to shaft-cooling plates is that the open type is preferable, since it does away with the necessity of using water under pressure, which constitutes a serious danger in case a plate cracks, and also because they can be easily cleaned. Open cooling plates require to be carefully designed; they must be kept completely filled with water and all air-lock at the top of the plate must be avoided. These shaft-cooling plates are to be found on most of the modern Continental plants, such as Dortmund Union, Hamborn, Uckingen, Rheinhausen, Gutehoffnungshütte, Dudelange and Caen.

The American practice is to line their furnaces with small bricks throughout, but larger bricks are the general rule in Continental furnaces. Silica bricks are used for the under hearth, aluminous bricks and carbon bricks for the hearth bottom, hearth walls and bosh. The present tendency on Continental furnaces is towards the use of silica bricks for the under hearth, carbon bricks for the hearth and bosh, owing to their capability of withstanding the scouring action of the slags and the great temperature variations, and aluminous bricks of high resistance to wear, for the shaft.

Furnace-Lining Bricks.

Aluminous Bricks.—Considerable progress has latterly been made in the manufacture of aluminous bricks, which can now be obtained with a proportion of "chamotte" or previously burnt selected fireclay as high as 90 per cent., and a proportion of water less than 5 per cent., with the result that practically no contraction occurs during the drying and baking processes, and the products remain perfectly even, with sharp corners and rigorously exact dimensions.

The resistance to crushing of ordinary aluminous bricks is 1,100 to 1,700 lbs. per sq. in.; special hearth bricks, with 39 to 42 per cent. alumina show 3,550 lbs. per sq. in., whilst special shaft bricks, containing 30 to 32 per cent. alumina, offer 8,500 to 11,500 lbs. per sq. in.—a good guarantee against shaft wear.

Silica Bricks.—Many Continental plants, such as Uckingen, Gutehoffnungshütte, Lübeck, Ijmuiden, are using acid bottoms on their large furnaces. These bottoms are giving good results on all classes of iron, and it is found that the bricks can be used again, when re-lining is necessary, since bears do not adhere to them. In building the hearth the silicon bottom is over-laid with the ordinary aluminous brick to a depth of 12 to 20 in., so that, on starting up the furnace, it will be heated up very slowly and the danger avoided of disintegrating the silica work owing to the rapid expansion which occurs at about 575 deg. Fah. The covering of aluminous brick is found to disappear rapidly, but it is always noted that the formation of bears stops as soon as the silica bottom is reached.

Carbon Bricks.—The use of carbon bricks for the hearth and bosh has had to combat a lot of prejudice, but is again much in vogue in Germany, having re-won the favour of the designers of the large furnaces at such plants at Gutehoffnungshütte, Essen, Hamborn, Bochum, Vulcan, Hoesch, Hattingen, Uckingen, Caen and Rehon. Carbon bricks were much used for lining hearths between 1900 and 1912, but caused much trouble and could by no means be then called a success. The troubles were, however, due to the fact that the modern continuous hearth jackets were then unknown, with the result that some carbon linings lifted and others were melted away, as a consequence of which tapholes were destroyed and break-outs a frequent occurrence.

It has been found that carbon bricks must be protected against direct contact with water and also against ingress of air from outside the walls, which explains the failure of carbon hearths in their earlier trials. The modern idea of the large high hearth, surrounded by a massive continuous jacket cooled without direct contact of the water with the lining, and with taphole stopped by the mud gun, has greatly improved conditions both for the refractory and the carbon lining. Nowadays the massive jacket is regarded rather as the principal feature of the hearth and not as an accessory, and it is because the carbon brick resists as well, if not better than, the aluminous brick, that the former has again come to the forefront in furnace construction.

The carbon brick appears to offer good resistance in furnaces working on all classes of iron. It possesses several great advantages—it is a bad conductor of heat, infusible, and highly resistant to the corrosive action of both acid and basic slags. Although it would be inexact to say that they absolutely prevent bear formation, nevertheless it is found that they do not tend to such formation.

Great care is used in the manufacture of these bricks. The primary material is hard, very pure coke of the best quality, the ash content in the best makes not exceeding 8 per cent.; this is ground very finely and mixed with 20 to 25 per cent. of the best steelworks dehydrated tar and the mixture compressed in thin successive layers by pneumatic hammers in metallic moulds. The moulds are then baked, at a temperature of 2,350 to 2,550 deg. Fah., completely covered with coke dust to protect them against the action of the air.

In laying the bricks, the joints should be reduced to the strictest minimum and a homogeneous fine mortar should be used; this mortar may consist of a mixture of fine coke dust and tar used hot, or a finely-ground mixture of coke dust and 20 per cent. of fine loam, with just sufficient water added to form a syrup.

During the blowing-in period, the bricks should be protected by a layer of lime or a course of firebricks, and, when normal conditions are established, they are claimed to be more refractory than ordinary bricks.

Blast-Furnace Operation.

Crushing and Screening of Ores.—The crushing and screening of ores, with subsequent briquetting or sintering of the fines, is considered an essential feature of modern Continental practice. In Continental practice the output capacities of furnaces with moderate sized hearths working on carefully-prepared burdens, are equal to those of American furnaces of larger sized hearths working on burdens which have not been prepared in this manner—the Continental practice is economical as the cost of preparing the materials of the charge is exceeded by the reduction in the cost of construction and production. It has been clearly demonstrated that the more uniform the size to which the whole of the materials comprising the charge can be charged, then the easier will be the working of the furnace. It would appear that the best range to aim for would be from 1½ to 3 in.

Flue Dust.—In the large-output furnace, with its high blast pressures and rapid driving, there is a high production of flue dust, especially if the amount of fine ore in the charge is excessive; the amount is especially high in the minette district at plants where the ore is crushed, but high dust loss is noticeable on all intensively-worked furnaces. One furnace in the minette area, making 425 tons a day, has blown over into the dustcatchers 11 per cent. of its ore charge, whilst 750-ton furnaces, on burdens containing 50 per cent. Swedish and 10 per cent. minette, have thrown over 13 per cent. of their ore charge, equivalent to 250 tons of dust per day.

The best method of reducing this flue-dust loss is the screening out and sintering of all fines. The use of large throats is also efficaceous, as recent results on these lines in America have shown.

Flue-Dust Recovery.—Owing to the high flue-dust losses, many processes have been brought out in order to recover the value of this dust, and it is now standard practice in Germany and the States to convert it into sinter, either alone or mixed with fine ores. Further progress has, however, recently been made, and two processes have been developed and are working successfully in Germany, in which the dust is prevented

from getting out of the furnace, the best method, after all, of getting rid of the dust.

One process is the "chain filter," which consists of a series of strong chains, suspended under the bell in a vertical position round the circumference of the throat, which forms an obstruction to the passage of the dust and through which the gas must travel on its way to the gas offtakes. The number of chains used at the gas offtakes is 70 to the yd., but only 40 to the yd. are used round the rest of the circumference. This arrangement prevents the gas from passing with too great a velocity into the offtakes, and forces it to make a detour to the more open parts of the filter, causing the gas current to divide itself up uniformly over the whole transverse section of the furnace. Not only has this filter at the Bochum works on a furnace making 900 tons per day on 15.33 cwts. of coke radically reduced the flue-dust loss, but has also lowered the coke consumption by slightly over half cwt., and the top gas temperature by 140 deg. Fah.

The other process is the Eichenberg, which consists of blowing into the furnace, above the top of the charge, clean blast-furnace gas and atomised water in the form of a horizontal filter, with a turbulent motion, by means of which the dust particles are stopped and forced to fall back into the furnace. For a 700-ton furnace, six gas and six water injectors are used, 88,000 cub. ft. of gas per hr. being injected under a pressure of three atmospheres, 1,550 galls. of water per hr. being used.

The British Blast Furnace.

In considering tonnages of American furnaces it should be remembered that a tonnage of 450 tons per day on a burden of Lake Superior ores of 44-per cent. iron content is equivalent to an output of 300 tons per day on a burden of British Midland ores with 30 per cent. iron content. Daily outputs of 800 and 900 tons are only possible in this country where the nature of the coke and ore is such as to result in easy reducibility and fast rate of combustion, and would require the most favourable conditions such as are obtainable in the United States.

The physical nature of the ore is of the greatest importance in blast-furnace operation, and is one of the chief determining factors on output capacity. The lean British Midland ores require 17 to 18 hrs. to pass through the furnace, whereas the easily reducible Mesabi ores require only 10 to 12 hrs., resulting in a great difference in furnace output in the two cases.

The slower development of blast-furnace outputs in this country, as compared with those ruling on the Continent and in the States, is probably chiefly due to the fact that the ore is, in the main, charged in the condition in which it is won from the mine. The large-hearth furnace is not too attractive a proposition when ore is charged in large lumps, since these lumps require longer time for their adequate reduction. Experience with furnaces fed with ores as mined, as in most British plants, shows that if the maximum economical limit of driving is overstepped, partially reduced ore arrives in the hearth, and the final reduction has to be done in this zone by means of solid carbon with a resulting increase in coke consumption and failure to produce marketable iron. This is typically borne out in Cleveland practice, where it is generally agreed that round about 16 hrs.' exposure to the gases is the economical limit with the ore charged as mined; reduction of this time results in increased loss of iron into the slag, and the sulphur content of the iron rises beyond all reasonable limits. It is a matter of almost daily routine with operators of these furnaces to have to check a furnace to keep "on grade."

There is no doubt that a lot can be done to obtain better furnace working, increase outputs, and reduce fuel consumptions, by suitable preparation of the raw materials before charging. The efficient screening and crushing of limestone, the sizing of coke and its efficient screening to remove all below one inch (the coke, however, must not be too small owing to solution loss effects), the sizing of ores, the crushing of large lumps, the removal of fines and sintering of these up to about 15 per cent. of the burden in basic practice and 30 per cent. in hematite practice, are all steps in the right direction as far as ideal furnace operation is concerned.

The iron content of the ore is of the greatest importance, and it is obvious that there is a great difference between the expenditure which can be wisely spent in treating ores of low iron contents and those rich in iron. If the cost of crushing an ore containing 30 per cent. iron is 6d. per ton, this means an increase of approximately 1s. 6d. per ton in the cost of production of the pig-iron. Even after allowance for the resultant advantages, such as easier driving and increased output, and consequent lower cost of conversion, the saving in coke consumption required to warrant the expenditure on crushing may, therefore, easily be more than can be obtained in practice. Assuming an increase in output of 10 per cent. in this case, it would be necessary to effect a reduction of about 1½ cwts. in coke consumption to make crushing a paying proposition. Treatment of such lean ores may, therefore, be quite unprofitable.

The proposition may, however, pay when the richer ores are dealt with. A crushing cost of 6d. per ton on a 60 per cent. ore, means an increase of approximately 9d. on the pig-iron cost. An increase in output of 10 per cent. in this case would require a reduction of only about ½ cwt. in coke consumption to justify the expenditure on crushing.

Crushing of ores is a decided advantage where the ores are hard, lumpy, refactory or magnetic, providing a coke strong enough to keep the furnace sufficiently open is used, this being especially necessary if the crushing results in the formation of much fines. Other methods of preliminary treatment which offer good possibilities are calcination and sintering, but here again geographical position and iron content may well be the deciding factor. The carbonate ores of Cleveland must, of course, be calcined, and it is essential for the best results to secure well-calcined stone free from clinker and unburnt stone.

The position is, however, different with the hydrated-oxide ores of the Midlands. The cost of transport here becomes the deciding factor; calcination is justified where the carriage is heavy, but it is doubtful whether calcination would pay in cases where these ores can be delivered at works in the raw state under 5s. per ton. Calcination of this class of ore should not be carried as far as is the practice with Cleveland, more especially so if the lime content is high, since this results in the production of an excessive amount of fines with detrimental effect on furnace working.

Sintering gives, in most cases, a very satisfactory product for furnace use. The cost of sintering is, however, 3s. to 4s. per ton on the finished product, and it is doubtful whether such treatment would pay, in the cases of lean ores, such as those of the Midlands, when delivered at works at less than 5s. per ton in the raw state.

Possible Output.

It is possible to construct in this country furnaces to produce 400 to 450 tons of basic iron per day, which would be equivalent to American results. These would, however, demand selected materials, which are only rarely obtainable under existing conditions. The author would also suggest a maximum make of 300 tons per day in the case of foundry iron.

With regard to the limit of effective hearth diameter, it would appear, in the light of recent results in Germany taken into consideration with the results in the United States on their large furnaces of 20 ft. dia. and over, that a consumption of about 250 lbs. of coke per square foot of hearth area per hr. is the maximum consistent with good work. Consideration of the various results leads one to the conclusion that this diameter limit is reached at about 16 to 17 ft. with unprepared materials, and 18 to 19 ft. with carefully-prepared materials, beyond which fuel economy is rather liable to fall.

The Production of Ferrous and Non-Ferrous Castings for High-Class Internal Combustion Engines.

(*Concluded from page* 176.)

ing the trouble would be overcome. When copper was red hot it oxidised and absorbed gases. Hydrogen was thrown out of solution as the metal cooled and the pinholes would appear. To de-oxidise he used phosphorus. Mr. White had said put the copper in last. It was advisable to put most of the copper in at the end, and he suggested the use of phosphor-copper put at the bottom of the pot. When tin was oxidised it could not be afterwards de-oxidised. If it were not put in early there would be that risk. Referring to Mr. White's statement that he thought the trouble due to the use of scrap copper, he (Mr. Russell) said he could use a large proportion of scrap copper. He added phosphor-copper, then after lifting the pot from the fire added the zinc and tin and poured the moulds at a temperature controlled by the pyrometer. Correct pouring temperature was essential. He thought Mr. White's mixtures were rather low in zinc, and there was a danger of the pinhole trouble. For high-pressure work he thought the Admiralty mixture of 88/10/2 would be successful. With regard to re-melting, he would again refer to the works of Mr. Dews, which stated that re-melting was not necessary.

Mr. White asked Mr. Russell for his opinion on the cause of tin sweat, and received the reply that it was undoubtedly due to incorrect pouring temperature.

Mr. P. A. Russell, referring to aluminium-bronze, said it was a difficult alloy. He would make ingots from aluminium and copper at 50 : 50 and use that to make up the mix. If one were using virgin copper he thought one must re-melt. Ordinary alloys did not necessitate re-melting.

A vote of thanks was proposed by Mr. Walter and seconded by Mr. S. H. Russell, to which Mr. White suitably replied.

The Late Mr. Dews.

The Branch-President, Mr. Spiers, referred to the regrettable death of Mr. H. C. Dews. His death would be a great loss to the industry. On a motion put to the meeting the Secretary was instructed to send a message of condolence to Mrs. Dews and also to the London Branch, which Branch Mr. Dews had so faithfully served.

The Iron-Zirconium Constitutional Diagram.—A complete iron-zirconium constitutional diagram is given in "Archiv für das Eisenhüttenwesen" for January last by R. Vogel and W. Tonn, based on cooling curves and examination of structures. They found a compound Fe_2Zr_3 (52.2 per cent. Zr) with the melting point 1,640 deg. C., which divides the diagram into two sections, in each of which there is an eutectic. The first eutectic, with 16 per cent. Zr, melts at 1,330 deg. C. In crystallisation from 0 to 16 per cent. Zr there is formed a solid solution with δ-iron, with a maximum of 7 per cent. Zr. The δ—γ change point of pure iron is lowered by increasing amounts of zirconium. The solubility of zirconium falls to 0.7 per cent. in the γ-iron solid solution, and on the breaking up of the latter at 830 deg. C it falls to at least 0.3 per cent. in α-iron. In the high-zirconium range there is an eutectic at 88 per cent. Zr, with a melting point of approximately 1,350 deg. C. A solid solution is formed which is saturated with 5 per cent. Fe on solidifying. On cooling a saturated solution containing 10 per cent. Fe in α-zirconium is formed at 1,000 deg. C.

Heat-Resisting Alloys.

The discussion which took place when Mr. J. Ferdinand Kayser read his Paper* on "Heat-Resisting Alloys" at Newcastle enabled the author to elaborate the views he expressed in his Paper.

The meeting was presided over by Mr. F. Allan, and the discussion was opened by Mr. Colin Gresty, who, after congratulating Mr. Kayser upon his Paper, said that it was of great educational value to everyone in the Newcastle district, for although they used the materials mentioned by Mr. Kayser, they were not made in the North. At one stage Mr. Kayser had referred to the necessity for adding carbon for strength, but at the sacrifice of malleability; would it be possible with heat-resisting material, which had to be rolled or forged, to add carbon afterwards by some form of cementation so as to obtain the required strength? Would it be possible to get strength as well as heat resistance? He would like Mr. Kayser to say a little more about strengths at high temperatures. It was rather surprising to hear him talking about a strength of three tons being wonderful. He had mentioned superheater supports; surely they would have to be made very heavy if the strength was so low? Was he able to show them a curve of the actual strengths at different temperatures?

"Silal" as Heat-Resisting Alloy.

Mr. R. O. Patterson said that he also had enjoyed Mr. Kayser's Paper. As Mr. Gresty had pointed out, the whole subject was outside the experience of North-East Coast foundrymen. Mr. Kayser had said that engineers required inherently heavy metal which was light and weak metal which was strong, but he had forgotten to mention that they also wanted it for nothing. That was what most of them were up against all the time. He was rather sorry that the lecturer had not touched a little more on heat-resisting cast iron. It was, of course, more or less out of the picture when one reached such abnormal temperatures—such temperatures as they in the North were not in the habit of catering for, as there was no trade in that part of the country which called for it. At the same time, he would like to repeat what he had already said in that room about "Silal" heat-resisting cast iron. Mr. Kayser had mentioned superheater-tube supports; they had made a quantity in "Silal," and obtained repeat orders. They did not want heat-resisting work to pass from their hands into the hands of the steel founders.

What Constitutes Cast Iron?

Mr. A. Logan asked the lecturer if he would explain why the addition of chromium to carbon alloys caused a drop in hardness. In his opinion, Mr. Kayser had said many contradictory things. He had mentioned that he thought there would not be much future for heat-resisting alloys of the cast-iron type, *i.e.*, the chromium-nickel types. When he was getting to 2½ per cent. of carbon, he was approaching the cast-iron range; it was, in fact, almost semi-cast iron. The question of sulphur attack on nickel alloys was well known, and he supposed the treatment with aluminium was a palliative. Why was the aluminium not incorporated with the alloy? The surface oxidation effect made from coating would be automatic, and there would not be the necessity of spraying. Perhaps this had been tried and found to be impracticable.

Chromium and Brittleness.

Mr. Eckford referred to Mr. Kayser's remarks on high-speed steel, and said that he had understood him to say that after repeated heating it eventually broke down. Surely that was rather against the process of high-speed steel, because the hotter it became the more efficiently it was supposed to work. Case-hardening boxes were an excellent field for heat-resisting alloys. He would like Mr. Kayser to enlighten them if he could as to the cost of those boxes as compared with the cost of ordinary steel boxes, which, of course, pulled and broke down after a few heats. He was rather interested in the same question as Mr. Logan, *i.e.*, the addition of chromium to the alloys in relation to brittleness. He had referred to testing specimens with the ordinary Buckton machine. As far as he was concerned, the time limit did not come into the test.

Strength at High Temperatures.

Mr. Kayser, referring to the question of carbon, said that none of the alloys case-hardened appreciably. He would not say that they did not case-harden at all, but very little sign of it would be found even in a case-hardening box which had been in use for years. With regard to strength at high temperatures, in mentioning a load of 3 tons per sq. in. at 800 deg. C., he had been referring to the safe load which the material would maintain for at least a year without changing dimensions. Of the various alloys which they manufactured, the safe load under those conditions ranged from 3 tons per sq. in. down to ⅓ ton per sq. in. In practice, however, in the majority of cases those alloys were used under loads greater than the safe load and consequently they did distort in time.

Mr. Kayser gave the following figures for strength at various temperatures, under a rate of loading of 44 lbs. per min.:—At 800 deg. C., 13.6 tons per sq. in.; at 900 deg. C., 9.4 tons per sq. in., and at 1,000 deg. C., 7.1 tons per sq. in. The strength of "Silal" under the same conditions was about 2½ tons per sq. in.

Price per Ton or per Hour?

Referring to the question of price, Mr. Kayser pointed out the necessity for comparing prices of heat-resisting materials on the basis of price per hour of life. Unfortunately, most people thought in terms of price per ton or per cwt., whereas what really mattered in the long run was the price per hour of life. Referring to Mr. Patterson's remarks regarding "Silal," he thought there was a good field for materials of that nature up to 700 deg. C. or even a little higher, so long as the price was not too high. They would not have to guarantee it to work at 1,000 deg. C., however.

Chromium and Ductility.

He had been asked a most difficult question—why did the addition of chromium increase ductility? He had to admit that he had not the remotest idea. Intermetallic compounds were very hard. NiAl had a melting point of 1,700 to 1,800 deg. C., right above that of either of the constituent metals. Several other intermetallic compounds were very hard. Generally speaking, homogeneous compositions were very soft. If one metal was added to another there was, of course, a change in hardness. When sufficient chromium was added to carbon alloys practically everything went into solution. When over 25 per cent. chromium was added to an alloy with 1.5 per cent. carbon content, or even if there was about 2½ per cent. carbon, it was essentially a solid solution.

With regard to the use of the words "cast iron," it was rather a play upon words. When the carbon content got up to 2 per cent. the metal was getting on to cast iron; that was why he did not like to use that expression. It always made him think of the material which came out of a sort of blast furnace and was cast into pigs. If one was going to call the metal produced "cast iron," he thought that pig-iron must be used as its base, but none of the types of alloys he had been talking about could be produced by using pig-iron. Therefore, as there was no cast iron in those alloys, he thought it was incorrect to call them cast-iron alloys. Many people doing research work talked of heat-resisting cast iron and started with a base of cast iron; they were unduly limiting themselves by keeping to that base. They would go very much further if they started with the alloys he had been speaking about. If they wanted to advance and progress they would do well to commence with alloys which were already in existence than to start with cast iron, although he quite appreciated the fact that no firm wanted to put themselves out of business. The great difference between the North and the South of England lay in the attitude of the controlling heads of businesses. In the South they looked upon a company as a money-making concern and they did not care much what they made. If they thought that it would pay by dropping cast iron and beginning to make bronze, they would put the new plant in and do it. In the North, if trade was bad, they would just shut up the works until it improved. If they had tried making alloys they would still have been foundrymen and turning out better casting than ever before, but they would not have been cast-iron castings.

Aluminium Additions.

Referring to the question of adding aluminium to the alloy, it had been done but aluminium was a difficult addition to make in the foundry. One of the photographs he had shown them had had the word "patent" on it and those castings had been made with the aluminium added. The trouble was that aluminium tended to pass out during the melting and if 7 per cent. of aluminium was added one got tool hardness. With two parts of nickel, one part of chromium and 7 per cent. of aluminium a high-speed turning tool was obtained. Metals thus became unworkable. A few days ago he had thought he would have another try at making aluminium alloys; he had used a high-frequency induction furnace. They would have been amazed if they could have seen the mess in the furnace; it was not like slag but like crushed brick on a wet day; it could not be handled.

He thought he had been rather misunderstood on the question of high-speed steel. He was talking about the continuous heating of high-speed steel. The point was that if a tensile test of a piece of high-speed steel was taken in the ordinary way one would get a tensile test of 20 tons per sq. in. at 800 deg. C. If a piece of one of their heat-resisting alloys was tested in the same way, the result would be 10 tons per sq. in. If, however, a weight of 3 tons per sq. in. was hung on to it and left on, the high-speed steel would continue to stretch and break after 24 hrs., whereas the nickel alloys had a life of perhaps three months.

Referring to the cost of a nickel-chromium alloy compared with the cost of high-speed steel, if a nickel alloy was used under proper conditions it would work out cheaper per hour of life.

With regard to the question of the time element in testing, Mr. Kayser said that at normal room temperatures, as long as more than half a minute was taken over the test, the final figure given of the maximum stress would be a true one. If the time of testing was cut down to a matter of seconds, then the apparent tensile strength went up. If the temperature rose, the time taken over the test would have to be proportionately longer to obtain the true figure. The best way was to hang on a weight and see what happened. It had been shown by Dickenson that the time element did enter in at normal temperatures, and in a Paper given about 1920 he had indicated that bridges such as they had at Newcastle would collapse in about ten million years. He thought it was really quite feasible.

Mr. James Smith proposed a hearty vote of thanks to Mr. Kayser, which was passed unanimously and to which Mr. Kayser briefly replied.

* See Foundry Trade Journal, Vol. 45, p. 412.

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This Week's News in Brief.

Trade Talk.

Messrs. U. A. Ritson & Sons, Limited, restarted their Burnhope Colliery, at Lanchester, Durham, on March 7.

Employees of Duncan Stewart & Company, Limited, Bridgeton, Glasgow, have contributed £119 to hospitals and local charities.

A special Russian trade section of the Sheffield Chamber of Commerce has been formed with the object of extending trade with Russia.

The employees of the Blantyre Engineering Company, Limited, Hamilton, held their annual social meeting and dance in Hamilton on March 4.

Messrs. Donovan & Company, electrical manufacturers and suppliers, have removed to larger premises at 46/47, Great Charles Street, Birmingham.

Admiralty contracts to be placed with the shipyards in the ensuing 12 months will represent a total of 60,000 tons, and an approximate value of £10,000,000.

The Duke of York finished his three days' tour of industrial Lancashire by paying a visit to the Partington steelworks of the Lancashire Steel Corporation, Limited.

The Brightside Foundry & Engineering Company, Limited, Sheffield, have been appointed sole distributors in the British Isles of "Micarta" roll-neck bearings.

Messrs. George Clark, Limited, Southwick, Sunderland, have received the order to engine the "Remois," a new Tees-built vessel which arrived in the Wear recently from Haverton Hill.

Messrs. Crossley Bros., Limited, have received an order from the British Broadcasting Corporation for four six-cylinder vertical Diesel engines, the total value of the engines being about £10,000.

Messrs. James Durrans, Limited, Phœnix Works, Penistone, near Sheffield, have changed their telegraphic address to "Blacking, Penistone." This should be very easy for foundrymen to memorise.

Mr. William A. Irvin, Vice-President of the United States Steel Corporation, has been nominated to succeed Mr. James A. Farrell as President. Mr. Farrell will remain a member of the directorate.

The Whessoe Foundry & Engineering Company, Limited, Darlington, has acquired the sole British rights for the Zschocke disintegrating plant for the cleaning of blast-furnace and other fuel gases.

The Capetown Corporation has placed an order with Messrs. C. A. Parsons & Company, Limited, Heaton Works, Newcastle-upon-Tyne, for a 20,000-kw. turbo-alternator and condensing plant for the Salt River Power Station.

The members of the Babcock & Wilcox Staff Association held a dance at the Wharncliffe Rooms, London, on Friday, March 4. Mr. H. W. Kolle presided, supported by two other directors of the company, Sir Robert Dixon and Colonel Greenly.

The twin-screw steamer "Krals Aleksander I," built by Lithgows, Limited, and engined by David Rowan & Company, Limited, Glasgow, for Dubrovacka, Parobrodska, Plovidba, A.D. Dubrovnik, Yugoslavia, has completed successful trials on the Clyde.

Messrs. Sir W. G. Armstrong, Whitworth & Company's marine engine department has just completed the conversion to superheated steam of the Anglo-American Oil Company's 17,000-ton oil tanker "Cadillac." The installation was completed in the contract time of 12 days.

A new phase of technical society activity has been inaugurated by the Malleable Club of Milwaukee, U.S.A., when a monthly meeting was given over to the discussion of estimates made by each member of the club on the basis of a casting blue print furnished by the Federal Malleable Company.

The businesses formerly carried on by Hans Renold, Limited, Renold Works, Didsbury, Manchester, and the Coventry Chain Company, Limited, Spon End, Coventry, have been taken over as from March 14 by the Renold & Coventry Chain Company, Limited, which will conduct its trading operations from the same addresses as the present companies. Brampton Bros., Limited, which was a direct subsidiary of the Coventry Chain Company, Limited, will, under the revised arrangement, become a direct subsidiary of the Renold & Coventry Chain Company, Limited, which will act as sole selling agents for its products.

The Pulsometer Engineering Company, Limited, Reading, have secured a contract from the Erith Urban District Council for equipping three automatically-controlled sewage stations. The plant will consist of four vertical-spindle-type Stereophagus pumps, two to be capable of delivering 1,200 g.p.m. each against a head of 60-66 ft. and absorbing 50 b.h.p. at 1,440 r.p.m., and two to deliver 850 g.p.m. each against 69-79 ft. head, absorbing 40 b.h.p. at 960 r.p.m. Two horizontal-type Stereophagus pumps for dealing with 275 g.p.m. each against 23 ft. head, absorbing 7½ b.h.p. at 725 r.p.m., complete the order. The Cape Town Corporation, South Africa, which already has a large number of Stereophagus pumps in use, has ordered two more of these pumps, to deliver 960 g.p.m. each against 62 ft. head. The Borough Council of Ilkeston has recently placed an order with the same firm for two 4-in. vertical-spindle motor-driven Fullway pumps, each capable of raising 150 galls. of sewage per min. against 28 ft. head, absorbing 6 b.h.p. at 960 r.p.m. The Pulsometer Engineering Company, Limited, is also to supply Newquay Waterworks with two turbine centrifugal pumps, to deliver 250 g.p.m. against a total head of 100 ft. Plant for the Wandle Valley Joint Sewerage Board consists of six 8-in., two 5-in. and two 4-in. Fullway pumps for sewage and storm-water pumping. The Orsett R.D.C. has ordered two electrically-driven turbine pumps.

Personal.

Mr. B. J. Colley has been appointed by Edgar Allen & Company, Limited, as their special representative for Brazil.

Sir Newton J. Moore has recently become President of the Dominion Steel & Coal Corporation, Limited, of Canada.

Prof. A. Portevin and Mr. Charles Dufour have been nominated honorary members of the Association Technique de Fonderie.

Mr. George H. Bucher has been elected Vice-President and general manager of the Westinghouse Electrical International Company.

Mr. Victor Stobie, President-Elect of the Institute of British Foundrymen, has changed his private address from Ryton-on-Tyne to Langholm, South Drive, Harrogate.

Mr. B. A. Johnson, of Messrs. R. D. Wood & Company, of Philadelphia, who was a recent visitor to this office, on his return addressed the members of the Philadelphia Foundrymen's Association on "Industrial Conditions in England."

Mr. S. Birchall, who for many years has been the Lancashire representative for Messrs. Spermolin, Limited, Halifax, has now been appointed by Messrs. Birchall & Lord, Limited, Rochdale, as their Lancashire and South Yorkshire representative.

Dr. Robert Salmon Hutton, Director of the British Non-Ferrous Metals Research Association, has been elected to the Goldsmiths Professorship of Metallurgy at Cambridge. Dr. Hutton will be the first holder of the appointment, which was created last year. The appointment dates from July 1 next.

Sir George Beharrell has been nominated to succeed Sir James Lithgow, Bt., as President of the Federation of British Industries for the coming year. Born at York in 1873, Sir George Beharrell was educated at Almondbury, Yorks, and Leeds University. Entering the service of the North Eastern Railway, he became assistant to the general manager, and assistant goods manager and commercial agent. His great knowledge of railways and commercial transport led to various appointments of importance during the war. He received a knighthood in 1919, and from 1919 to 1922 was Director-General of Finance and Statistics at the Ministry of Transport. He is now managing director of the Dunlop Rubber Company, Limited.

Major Dugald Baird, of Kaimshill, Muirkirk, has retired after serving for 31 years as manager of Messrs. Wm. Baird & Company's ironworks and collieries at Lugar and Muirkirk. Major Baird, who is a native of Annick Lodge, near Irvine, commenced his career with Messrs. M'Creaths & Stevensons, mining engineers, Glasgow. After obtaining a manager's certificate he received an appointment with the Fife Coal Company, Limited, holding the position for 12 years. After a short period in the North of England, Major Baird was appointed manager to Messrs. Wm. Baird & Company, Limited, at Lugar, where he served for 14 years prior to his transfer to Muirkirk. At Muirkirk he has been in charge for a period of 17 years, the company now being known as Bairds & Dalmellingtons, Limited. Major Baird was connected with the Artillery Volunteers, Glasgow, for 24 years, receiving the long-service medal, and during the war he was in the Reserve Forces at home for three years. On several occasions he has officiated as examiner at mining examinations. He is a Justice of Peace for the county of Ayr.

Sir Henry Fowler was elected President of the Institute of Metals on Wednesday, March 9. Born in 1871, he was educated at Evesham and Mason Science College (now the University of Birmingham). He served an apprenticeship at the locomotive works of the Lancashire & Yorkshire Railway at Horwich, and was for a considerable time engaged in the test office there. He conducted classes in engineering and metallurgical subjects at the Mechanics' Institute. In 1900 he joined the staff of the Midland Railway Company at Derby, becoming successively gas engineer, assistant works manager, and works manager. In 1910 he became chief mechanical engineer, holding this position until the amalgamation of the railways in 1923, when he became deputy chief mechanical engineer of the London Midland & Scottish Railway, and in 1925 was appointed chief mechanical engineer of this railway. He has read numerous Papers before the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Locomotive Engineers, etc., and quite recently received the distinction of being elected an honorary life member of the Institution of Mechanical Engineers. He gave the second autumn lecture to the Institute of Metals in 1923 on "The Use of Non-Ferrous Metals in Engineering," and has been awarded the gold medal of the Institute of Transport for his Paper on "Locomotive Repairs." He has had conferred upon him the honorary degree of LL.D. by the University of Birmingham, and of D.Sc. by the University of Manchester, and is the first honorary graduate of the Manchester College of Technology. In 1931 Sir Henry relinquished his position as chief mechanical engineer of the L.M.S. Railway on his appointment as assistant to the Vice-President for research and development.

Wills.

Walker, T. S., of Edgbaston, director of Tangyes, Limited	£43,047
Yarrow, Sir Alfred, Bt., F.R.S., marine engineer and shipbuilder ...	£241,387
Simons, William, general manager of the Cardiff-Dowlais Works of the British (Guest Keen Baldwins) Iron & Steel Company, Limited, chairman of the Cambrian Wagon Company, Limited, a director of Messrs. Guest, Keen & Nettlefolds, Limited, managing director of Messrs. Guest, Keen & Piggotts, Limited, and a director of the Norton & Biddulph Collieries, Limited	£35,820

Obituary.

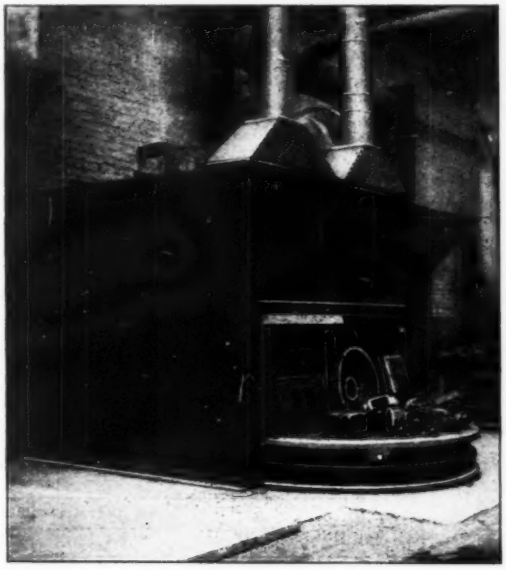
Mr. Robert Mackie, for many years foreman at the Gowanbank foundry of Messrs. M. Cockburn & Company, Limited, died on March 5, in his 84th year.

Mr. George Eskholme Buttenshaw, who was formerly associated, in the capacity of engineer, with Messrs. Guest & Chrimes, Limited, brassfounders, Rotherham, died recently.

Mr. James Russell, a native of Newmains, died on March 11, in his 91st year. He was one of a group of Lanarkshire business men who formed Pather Iron & Steel Company, Limited, Wishaw, and held the post of secretary and director until he retired recently.

Holes in castings may be filled with the following: Sulphur, one part; sal-ammoniac, two parts; iron filings, 80 parts; make into a paste with water.

In the Court of Appeal, before the Master of the Rolls and Lord Justices Lawrence and Romer, the appeal of Brackelsberg Processes, Limited, against the judgment delivered by Mr. Justice Luxmore in favour of Pittevil & Company was disallowed.



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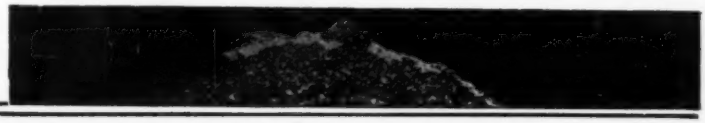

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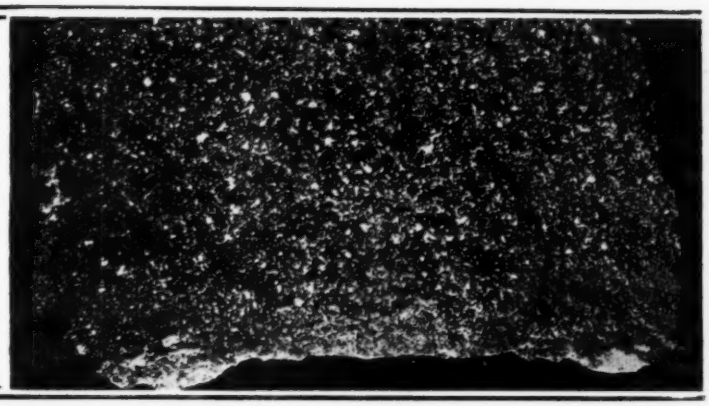

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Raw Material Markets.

There is a better tone in the iron and steel markets, owing to the more numerous, if small, orders. There has been a slight improvement in the demand from overseas, and the increased inquiries promise more business to come. Sales of pig-iron to home consumers remain on a limited scale, owing to the large stocks that are still in existence. Hardly any forward purchases have been negotiated. Although the competitive power of Continental semis has been improved by the rise in sterling, few orders are being taken, as many consumers made heavy purchases before the imposition of the tariff. The demand for finished steel is poor, by reason of the continued decline in the shipbuilding, heavy engineering and other consuming industries.

Pig-Iron.

MIDDLESBROUGH.—Consumers are still very cautious, and hand-to-mouth buying remains general. There has, however, been a slight improvement in contract deliveries, and it is hoped that heavier renewals will be negotiated at the end of the current month. The output of the six furnaces producing Cleveland iron is being well absorbed. Sales to Scotland are limited, although four cargoes totalling 2,300 tons were shipped to Grangemouth in the week before last. Special prices are being offered in Glasgow. Quotations are:—No. 1 Cleveland foundry iron, 61s. per ton; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry iron, 57s. 6d.; No. 4 forge, 57s. per ton, f.o.t.

Orders are still scarce in the East Coast hematite market, and prices are low, mainly owing to selling by over-stocked merchants, as the makers are firm in their quotations. At the moment, mixed numbers can be bought at 63s. 6d. per ton, or even less. In the West Coast hematite market, several U.S. inquiries are circulating, and the export outlook is more promising. Local consumption has been small, and the makers have heavy stocks of unsold iron. Bessemer mixed numbers remain at 66s. per ton at works.

LANCASHIRE.—An increase of contract buying is reported by the Midlands producers, in some cases to cover the next three or four months. Deliveries to Lancashire foundries remain at the level of the last few months, except in the case of the general foundries, which are still very short of work. Current quotations for delivery to consumers in the Manchester price zone are on the basis of 67s. per ton for Derbyshire and Staffordshire No. 3 brands, with North-East Coast makes also at 67s., Northamptonshire at 65s. 6d., Derbyshire forge at 62s., Scottish foundry at around 87s., and West Coast hematite at about 81s. Sales of Indian iron for delivery to users in the Manchester district are reported at about 77s. 6d. per ton.

MIDLANDS.—Although there was a spurt in deliveries to consumers at the beginning of the month, it has now died down, and the makers are forced to pass some of their iron into stock. Hardly any forward business has been arranged, as, although many contracts are nominally due to expire at the end of this month, deliveries have been so cut down that no new agreements will be needed until the end of April or early May. Current quotations are 62s. 6d. for No. 3 Northamptonshire and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3, including delivery to Birmingham and Black Country stations.

SCOTLAND.—The foundries are badly in need of work, and new business for pig-iron is very scarce. No. 3 Scottish foundry remains at 69s. 6d. per ton, with 2s. 6d. extra for No. 1, at furnaces. Other English irons are 1s. to 1s. 6d. less. Continental material is off the market at the moment. Many consumers still hold large tonnages of the latter, which they bought before the tariff came into operation.

Coke.

There has been little change in the demand for coke and prices remain unaltered. No forward buying of note has been reported. Durham foundry coke, delivered Birmingham, is quoted at 37s. 6d. per ton for best grades, with lower grades at 35s., while Welsh coke varies from 30s. to 45s. per ton, according to analysis.

Steel.

Trade remains dull in the finished-steel market owing to the continued scarcity of work in the shipbuilding and heavy engineering industries. There is no sign of any early improvement in conditions. The price of Continental semis has been lowered by the improvement in sterling, but transactions are only for immediate delivery, and no forward business is being arranged. The majority of consumers are already well stocked.

Scrap.

In the Cleveland market sales of heavy cast-iron scrap remain on a limited scale, and supplies are on offer at 42s. 6d. per ton, with machinery quality at 45s. and light metal at 36s. There is a similarly slack demand in the Midlands market, where machinery scrap is weak at 47s. 6d. per ton delivered, with clean light at 37s. 6d. to 40s. per ton delivered. Little interest is being shown by Welsh and Scottish consumers.

Metals.

Copper.—The market has benefited by the slight easing in sterling rates and by the favourable outcome of the producers' conference in New York. From April 1 the output is to be curtailed to 20 per cent. of capacity, the present rate being 26½ per cent. The old marketing rules of the Copper Exporters, Inc., are to be adhered to for the present. It is estimated that the world consumption will exceed the restricted output, thus enabling the huge stocks of unsold copper at present in existence to be liquidated. These definite steps taken in the face of a crisis have considerably heartened the market, although an even greater cut in production was expected in some quarters. There has yet, however, to be an improvement in domestic consumption in this country and in the U.S.A., where spot offers of cheap metal have been made at the record low level of 5.50 cents per lb. delivered.

Closing quotations:—

Cash.—Thursday, £33 2s. 6d. to £33 5s.; Friday, £32 17s. 6d. to £33; Monday, £33 12s. 6d. to £33 15s.; Tuesday, £33 6s. 3d. to £33 7s. 6d.; Wednesday, £33 7s. 6d. to £33 10s.

Three Months.—Thursday, £33 10s. to £33 12s. 6d.; Friday, £33 2s. 6d. to £33 5s.; Monday, £33 15s. to £33 17s. 6d.; Tuesday, £33 5s. to £33 7s. 6d.; Wednesday, £33 5s. to £33 7s. 6d.

Tin.—Fluctuations in sterling have tended to disturb the market, but there has been a steady if limited demand from consumers. Little business has been done with the Continent, owing to exchange difficulties, and the prevailing industrial depression in Western Europe. Consumption in the United States remains at a low level. The January statistics were much as expected, the general indication being that the level of production is now falling to that of consumption. There are still enormous stocks of tin, however, which will have to be liquidated before the market is once more in a firm position.

Official closing prices:—

Cash.—Thursday, £130 7s. 6d. to £130 12s. 6d.; Friday, £130 12s. 6d. to £130 17s. 6d.; Monday, £129 15s. to £129 17s. 6d.; Tuesday, £128 to £128 5s.; Wednesday, £129 15s. to £129 17s. 6d.

Three Months.—Thursday, £132 to £132 5s.; Friday, £132 5s. to £132 10s.; Monday, £131 7s. 6d. to £131 10s.; Tuesday, £129 15s. to £130; Wednesday, £131 7s. 6d. to £131 10s.

Spelter.—The improvement in sterling, and the consequent fall in price, led to considerable selling by holders of stocks, from which the market has not yet recovered. Buyers have been impressed by the large imports of spelter which took place during February, and little forward business has been arranged.

Daily fluctuations:—

Ordinary.—Thursday, £12 16s. 3d.; Friday, £12 13s. 9d.; Monday, £12 13s. 9d.; Tuesday, £12 10s.; Wednesday, £12 3s. 9d.

Lead.—Demand has been quiet in this country, consumers' present stocks being sufficient for some weeks ahead. Very little business is being done on the Continent. In view of the recent heavy imports, prices are likely to remain easy for some time.

The week's prices have been:—

Soft Foreign (Prompt).—Thursday, £12 13s. 9d.; Friday, £12 10s.; Monday, £12 12s. 6d.; Tuesday, £12 6s. 3d.; Wednesday, £12 3s. 9d.

Australian Tariff Amendments.

REDUCED RATES ON IRON AND STEEL.

The High Commissioner for Australia (Sir Granville Ryrie) has received cabled advice from the Commonwealth Government of various amendments made in the Australian Tariff, with effect on February 26 last. The following extracts from the schedule of amendments show that the rates of duty on certain classes of iron and steel products have been reduced. The table gives the old and the new rates, per ton, under the British Preferential Tariff and the General Tariff:—

Tariff item.	Description.	Old rates.		New rates.	
		B.P.T.	G.T.	B.P.T.	G.T.
		s. d.	s. d.	s. d.	s. d.
136 (A)	Pig-iron	25 0	45 0	20 0	40 0
(B)	Ingots, blooms, billets, etc.	42 0	75 0	32 0	65 0
(C) (1)	Iron and steel bars, rods, angles, tees, etc.	80 0	130 0	70 0	120 0
143	Scrap iron	25 0	45 0	20 0	40 0
155	Iron or steel beams, channels, joists, girders, columns, trough and bridge iron or steel—				
	(*a*) not drilled or further manufactured	80 0	135 0	70 0	125 0
	(*b*) drilled or further manufactured ..	80 0	135 0	70 0	125 0
	and in addition *ad valorem*	35 per cent.	45 per cent.	25 per cent.	35 per cent.

Other items of interest to the iron, steel and allied industries on which the rates have been reduced are:—Locomotives and road rollers, from 55 per cent. to 40 per cent. *ad valorem* under the British preferential tariff and from 75 per cent. to 55 per cent. under the general tariff; wrought-iron and steel chains composed of welded links, manufactured from metal ½ in. dia. and over, and chain, roller and inverted-tooth types, from 60 per cent. to 10 per cent. under the general tariff, and free under the preferential tariff against an *ad valorem* duty of 50 per cent. previously; machine driving, sprocket and link belting of malleable cast iron, from 50 per cent. to 1¼d. per lb. or 30 per cent. *ad valorem* (whichever rate returns the higher duty) under the preferential duty and from 60 per cent. to 2½d. per lb. or 40 per cent. under the general tariff; chain and chains, not elsewhere indicated, from 50 per cent. to 27½ per cent. preferential and from 60 per cent. to 40 per cent. general; malleable-iron castings, not elsewhere specified, 2d. per lb. or 45 per cent. against 4d. or 45s. preferential and 2½d. or 60 per cent. against 6d. or 60 per cent. general; steel or iron wheels and steel-tyred wheels for use of railways and tramways, except cast-iron or steel wheels 14 in. dia. or under, from 45 per cent. to 35 per cent. British preferential and 65 per cent. to 55 per cent. general tariff.

An addenda states that the deferred duties of 20 per cent. (British preferential tariff) and 35 per cent. (general tariff) which were to apply under Item 197B (cutlery, spoons and forks, not elsewhere indicated) at some future date to be determined by the Minister for Trade and Customs have been withdrawn.

Barbed wire, baths and sinks have been removed from the list of articles which were prohibited by Customs Proclamation No. 186 (operative from April 4, 1930) from importation into Australia except with the written consent of the Minister for Trade and Customs.

Files can be cleaned of aluminium by dipping in a strong caustic soda solution, wiping, washing in water and drying in sawdust.

Sterling

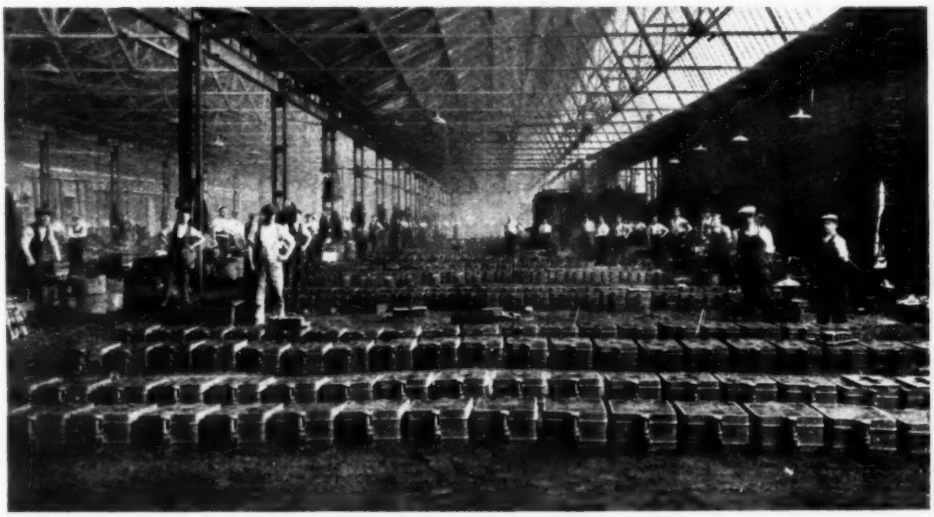
MOULDING BOXES

Stand up to the exacting Requirements of the Modern Foundry

because

They are made from Rolled Steel

Over 2,500 pairs of STERLING BOXES are in daily use in the Foundry of Messrs. THOS. L. HALE (Tipton) LTD., DUDLEY PORT, Malleable Ironfounders.



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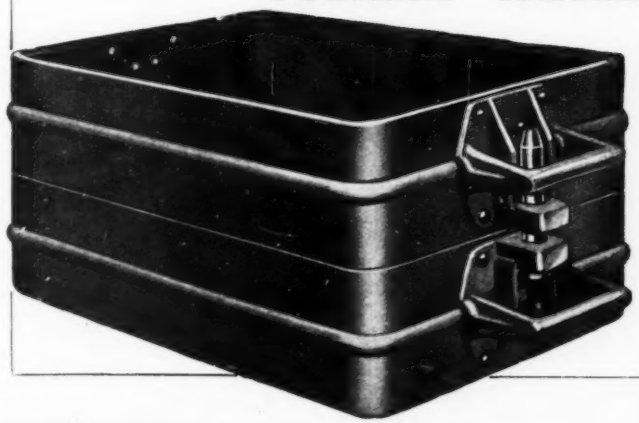
STERLING

FOUNDRY SPECIALTIES LTD.,

BEDFORD.



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Telegrams: "STERFLASK, BEDFORD."
Code: Western Union.

London Office:
13, VICTORIA STREET, S.W.1.

YOU CAN RELY ON THE NAME

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	33 7 6
Three months	33 5 0
Electrolytic	36 10 0
Tough	35 0 0
Best selected	35 5 0
Sheets	66 0 0
India	47 0 0
Wire bars	38 0 0
Do., April	37 15 0
Do., May	37 10 0
Ingot bars	38 0 0
H.C. wire rods	41 0 0
Off. av. cash, Feb.	36 19 8
Do., 3 mths., Feb.	36 14 2
Do., Sttlmnt., Feb.	36 19 3
Do., Electro, Feb.	41 15 11
Do., B.S., Feb.	40 10 0
Do., wire bars, Feb.	42 4 3
Solid drawn tubes	10d.
Brazed tubes	10d.
Wire	6¾d.

BRASS.

Solid drawn tubes	9¼d.
Brazed tubes	11¼d.
Rods, drawn	8¼d.
Rods, extd. or rlld.	4¼d.
Sheets to 10 w.g.	7¾d.
Wire	7¼d.
Rolled metal	7¼d.
Yellow metal rods	4¼d.
Do. 4 × 4 Squares	5¼d.
Do. 4 × 3 Sheets	5¼d.

TIN.

	£ s. d.
Standard cash	129 15 0
Three months	131 7 6
English	131 0 0
Bars	131 5 0
Straits	130 15 0
Australian	129 10 0
Eastern	134 7 6
Banca (nom.)	138 0 0
Off. av. cash, Feb.	139 4 7
Do., 3 mths., Feb.	141 17 2
Do., Sttlmt., Feb.	139 4 6

SPELTER.

	£ s. d.
Ordinary	12 3 9
Remelted	10 10 0
Hard	10 0 0
Electro 99.9	15 0 0
English	13 5 0
India	11 10 0
Zinc dust	23 0 0
Zinc ashes	2 17 6
Off. aver., Feb.	14 1 7½
Aver. spot, Feb.	13 17 5½

LEAD.

	£ s. d.
Soft foreign ppt.	12 3 9
English	14 5 0
Off. average, Feb.	14 11 3½
Average spot, Feb.	14 11 2½

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	24 10 0
Do., V.M. ex-whf.	22 15 0
Rods	29 0 0
Boiler plates	—
Battery plates	—

ANTIMONY.

	£ s. d.
Special brand Eng.	40 0 0
Chinese	28 0 0
Crude	22 0 0

QUICKSILVER.

	£ s. d.
Quicksilver (nom.)	18 2 6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£7 10 0
45/50%	£11 12 6
75%	£17 15 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free, 4/2, plus 55%, per lb. of Mo.	
Ferro-titanium—	
23/25% carbon-free	11¼d. lb.
Ferro-phosphorus, 20/25%	£21 10 0
Ferro-tungsten—	
80/85%	1/8½ lb. plus 20%
Tungsten metal powder—	
98/99%	1/11½ lb. plus 20%
Ferro-chrome—	
2/4% car.	£37 10 0
4/6% car.	£26 0 0
6/8% car.	£23 7 6
8/10% car.	£23 0 0
Ferro-chrome—	
Max. 2% car.	£40 2 6
Max. 1% car.	£55 0 0
Max. 0·70% car.	£57 10 0
70%, carbon-free	1/1½ lb.
Nickel—80/99.5%	£230 to £235
Ferro-cobalt	9/9 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	3/- lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 0 0
Metallic manganese—	
94/96% carbon-free	1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 3/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¼ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£ s. d.	£ s. d.
South Wales—		
Heavy steel	2 5 0	to 2 6 0
Bundled steel and shrngs.	1 17 0	to 1 18 0
Mixed iron and steel		2 0 0
Heavy cast iron	2 6 0	to 2 7 0
Good machinery for foundries		2 10 0
Cleveland—		
Heavy steel		1 15 0
Steel turnings		1 12 6
Cast-iron borings		1 6 0
Heavy forge		2 15 0
W.I. piling scrap		2 7 6
Cast-iron scrap	2 2 6	to 2 5 0
Midlands—		
Light cast-iron scrap		1 17 6
Heavy wrought iron		2 12 6
Steel turnings, f.o.r.		1 2 6
Scotland—		
Heavy steel	1 17 6	to 2 0 0
Ordinary cast iron		2 8 6
Engineers' turnings		1 9 0
Cast-iron borings		1 11 6
Wrought-iron piling		2 5 0
Heavy machinery		2 12 6

London—Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	28 0 0
Brass	21 0 0
Lead (less usual draft)	11 0 0
Tea lead	8 0 0
Zinc	6 10 0
New aluminium cuttings	70 0 0
Braziery copper	24 0 0
Gunmetal	24 0 0
Hollow pewter	80 0 0
Shaped black pewter	60 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	64/-
Hematite M/Nos.	63/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	73/-
d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
No. 4 forge*	61/-
No. 3 fdry.*	66/-
Shrops basic	—
Cold blast, ord.	—
roll iron	—
Northants forge*	57/6
fdry. No. 3*	62/6
fdry. No. 1*	65/6
Derbyshire forge*	61/-
fdry. No. 3*	66/-
fdry. No. 1*	69/-
basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
fdry. No. 3	63/6
Lincs forge	—
fdry. No. 3	63/6
E.C. hematite	74/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	87/-
Clyde, No. 3	87/-
Monkland, No. 3	87/-
Summerlee, No. 3	87/-
Eglinton, No. 3	87/-
Gartsherrie, No. 3	87/-
Shotts, No. 3	87/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£ s. d.	£ s. d.
Iron—		
Bars (cr.)	9 15 0	to 10 0 0
Nut and bolt iron	8 7 6	to 8 10 0
Hoops	10 10 0	to 12 0 0
Marked bars (Staffs) f.o.t.		12 0 0
Gas strip	10 10 0	to 12 0 0
Bolts and nuts, ¾ in. × 4 in.		12 2 6
Steel—		
Plates, ship, etc.	8 15 0	to 8 17 6
Boiler plts.	8 10 0	to 9 5 0
Chequer plts.		10 7 6
Angles		8 7 6
Tees		9 7 6
Joists		8 15 0
Rounds and squares, 3 in. to 5½ in.		9 7 6
Rounds under 3 in. to ¾ in. (Untested)	6 15 0	& up.
Flats—8 in. wide and over		8 12 6
„ under 8 in. and over 5 in.		8 17 6
Rails, heavy	8 5 0	to 8 10 0
Fishplates		12 0 0
Hoops (Staffs)		9 10 0
Black sheets, 24g.	8 0 0	to 8 10 0
Galv. cor. shts.	9 10 0	to 10 5 0
Galv. flat shts.	10 0 0	to 11 5 0
Galv. fencing wire, 8g. plain		12 10 0
Billets, soft	5 7 6	to 5 12 6
Billets, hard		6 12 6
Sheet bars	4 15 0	to 5 5 0
Tin bars		4 15 0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10¾d.
Sheet to 10 w.g.	11¾d.
Wire	12¾d.
Rods	11¾d.
Tubes	16¾d.
Castings	12¾d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	15.64
No. 2 foundry, Valley	15.00
No. 2 foundry, Birm.	11.00
Basic	16.39
Bessemer	17.39
Malleable	17.39
Grey forge	16.89
Ferro-mang. 80%, seaboard	75.00
O.-h. rails, h'y, at mill	43.00
Billets	27.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.50
Tank plates	1.50
Beams, etc.	1.50
Skelp, grooved steel	1.50
Skelp, sheared steel	1.50
Steel hoops	1.65
Sheets, black, No. 24	2.15
Sheets, galv., No. 24	2.75
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	22/6 to 27/6
„ furnace	17/6 to 18/6
Durham and Northumberland—	
„ foundry	14/6 to 15/-
„ furnace	14/- to 14/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	16/-
„	28×20 „	32/-
„	20×10 „	23/6
„	18¾×14 „	16/7½
C.W.	20×14 „	14/-
„	28×20 „	30/-
„	20×10 „	20/- to 20/6
„	18¾×14 „	14/6

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars, hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	*Fittings.*
Gas	65%	57½%
Water	61½%	52½%
Steam	57½%	47½%

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Mar. 10	33	2	6	inc.	5/–
„ 11	32	17	6	dec.	5/–
„ 14	33	12	6	inc.	15/–
„ 15	33	6	3	dec.	6/3
„ 16	33	7	6	inc.	1/3

Electrolytic Copper.

	£	s.	d.		
Mar. 10	36	5	0	dec.	15/–
„ 11	36	5	0	No change	
„ 14	36	15	0	inc.	10/–
„ 15	36	10	0	dec.	5/–
„ 16	36	10	0	No change	

Standard Tin (cash).

	£	s.	d.		
Mar. 10	130	7	6	inc.	10/–
„ 11	130	12	6	„	5/–
„ 14	129	15	0	dec.	17/6
„ 15	128	0	0	„	35/–
„ 16	129	15	0	inc.	35/–

Tin (English ingots).

	£	s.	d.		
Mar. 10	131	15	0	inc.	10/–
„ 11	132	0	0	„	5/–
„ 14	131	0	0	dec.	20/–
„ 15	129	5	0	„	35/–
„ 16	131	0	0	inc.	35/–

Zinc Shee's (English).

	£	s.	d.		
Mar. 10	24	10	0	No change	
„ 11	24	10	0	„	„
„ 14	24	10	0	„	„
„ 15	24	10	0	„	„
„ 16	24	10	0	„	„

Spelter (ordinary).

	£	s.	d.		
Mar. 10	12	16	3	inc.	1/3
„ 11	12	13	9	dec.	2/6
„ 14	12	13	9	No change	
„ 15	12	10	0	dec.	3/9
„ 16	12	3	9	„	6/3

Lead (English).

	£	s.	d.		
Mar. 10	14	15	0	No change	
„ 11	14	10	0	dec.	5/–
„ 14	14	10	0	No change	
„ 15	14	5	0	dec.	5/–
„ 16	14	5	0	No change	

Imports and Exports of Iron and Steel Castings in February and the two months 1932, compared with February and the two months 1931.

	February, 1931.	February, 1932.	Two months, 1931.	Two months, 1932.	February, 1931.	February, 1932.	Two months, 1931.	Two months, 1932.
Imports.	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Pipes and Fittings, Cast	767	580	2,073	768	8,968	8,051	25,747	11,202
Castings, in the Rough, Iron	216	154	382	177	3,881	2,963	7,515	3,430
„ „ „ Steel	621	441	1,231	688	14,196	9,430	27,751	13,603
Hollow-ware, Cast, not Enamelled	6	1	15	1	369	76	1,023	76
„ „ Enamelled	26	3	27	3	996	291	1,052	323
Exports.								
BUILDERS' CASTINGS—								
To Argentine Republic	87	19	190	73	3,474	941	8,696	3,347
„ Irish Free State	266	325	643	740	12,571	13,117	31,211	31,915
„ British South Africa	106	105	263	301	4,708	3,864	10,928	10,688
„ „ India	102	94	229	167	3,544	3,247	7,868	5,844
„ New Zealand	26	20	88	41	1,010	1,466	5,012	2,399
Total (including other countries)	870	867	2,151	2,053	39,845	35,425	100,319	86,276
PIPES AND FITTINGS—CAST—								
To Argentine Republic	416	266	1,267	397	3,977	2,836	12,044	4,117
„ Irish Free State	767	788	1,411	1,357	8,911	10,679	17,126	18,262
„ British South Africa	1,175	611	2,111	1,393	15,309	6,842	25,569	16,174
„ „ India	140	112	279	214	2,476	1,663	5,787	3,351
„ Straits Settlements and Malay States	275	189	352	876	2,889	1,627	4,335	7,986
Total (including other countries)	6,888	6,334	13,182	12,274	75,376	55,578	149,753	124,522
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	205	175	454	341	6,729	6,930	14,575	12,941
„ Enamelled	80	38	118	90	7,557	3,671	11,410	8,046
CASTINGS, in the rough—								
Iron	224	75	327	155	8,857	2,988	12,565	6,201
Steel	77	67	231	194	3,526	3,107	9,776	7,173

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